# AVIATION WEEK

A McGRAW-HILL PUBLICATION

MORE AIR FORCE PER DOLLAR
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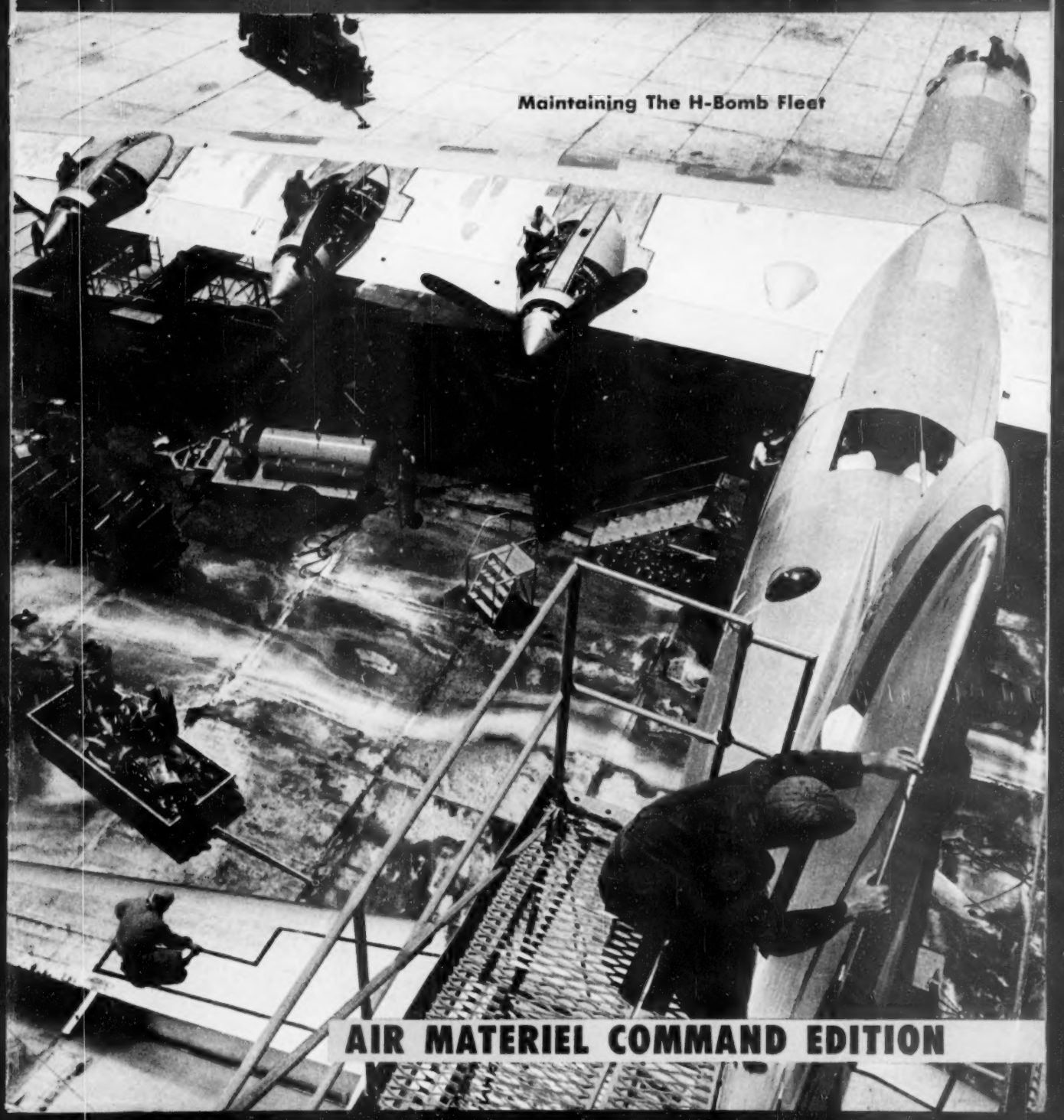

Maintaining The H-Bomb Fleet

## AIR MATERIEL COMMAND EDITION

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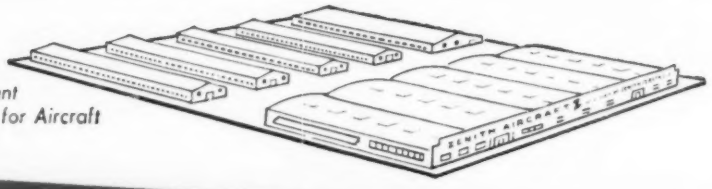
The sky is literally the limit with the new, vastly expanded facilities for reinforced plastic production of Zenith Aircraft—Division of Zenith Plastics Co. New ideas—new developments—tremendously broadened horizons in Radar and Electronic applications, Guided Missiles and primary structures in aircraft—will result from Zenith's continuous program of research. Write for brochure "Futures Unlimited" for a picture of progress and a glimpse of a future without limitations, to Zenith Aircraft, Division of Zenith Plastics Co., Gardena, Calif.

*World's Largest Plant*
*devoted to the production of Reinforced Plastics for Aircraft*

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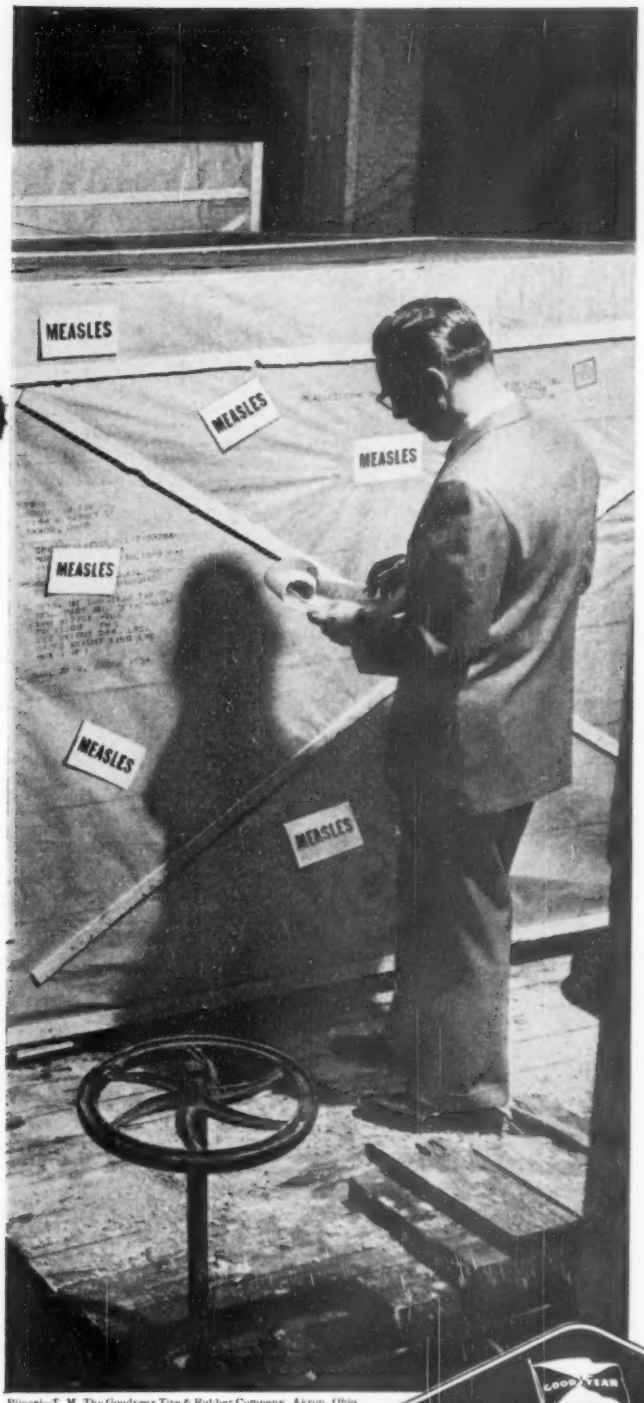


Pliocel—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

# WE'RE SHIPPING MEASLES BY THE CARLOAD —*for the B-52!*

"MEASLES"—that's the code word used to identify shipments of main fuel tanks built by Goodyear for the Boeing B-52 jet bomber.

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The quality control governing the production of Goodyear Aviation Fuel Cells is, we believe, the most thoroughgoing in its field.

For example, the B-52 tank is subjected to exhaustive testing in accordance with applicable Military Specifications. In addition each tank is phenol tested to assure a fuel tight container, jig checked to assure proper fit in the airplane—plus a detailed inch-by-inch inspection of each tank after curing.

The fittings—and there are more than 80 of them in a set of these Boeing tanks—are critically examined through profilometer, thread, M.D.G., micrometer, vernier caliper, torque gauge checks before they are finally okayed for shipment under the "measles" label.

This tremendous investment in man power and testing equipment is a major factor in the universal acceptance of Goodyear Fuel Cells—whether they be small Pliocels, giant bladder cells, rip-ram-proof or bullet-sealing units.

That's why so many commercial, military and private aircraft rely on Goodyear Fuel Cells. Experience *proves* you can depend on their performance!

Goodyear, Aviation Products Division
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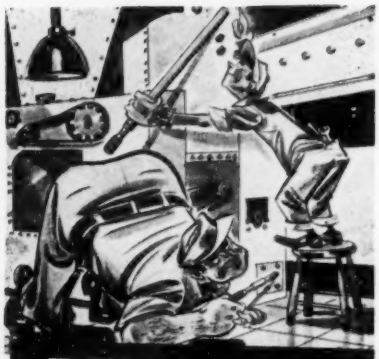

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PROTO means PROfessional TOols

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# AVIATION WEEK

August 16, 1954
Volume 61 Number 7

**CONTENTS FOR THIS EDITION on PAGE 69**

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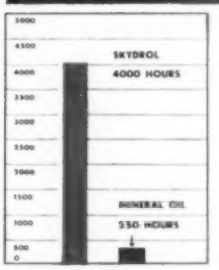
# Air Force Adopts SKYDROL For C-118A Superchargers

**After test studies** lasting more than a year, fire-resistant Skydrol hydraulic fluid is now specified for the superchargers of all new Douglas C-118's of the Military Air Transport Service. With this improvement, chemical-base Monsanto fluid will replace present petroleum oils.

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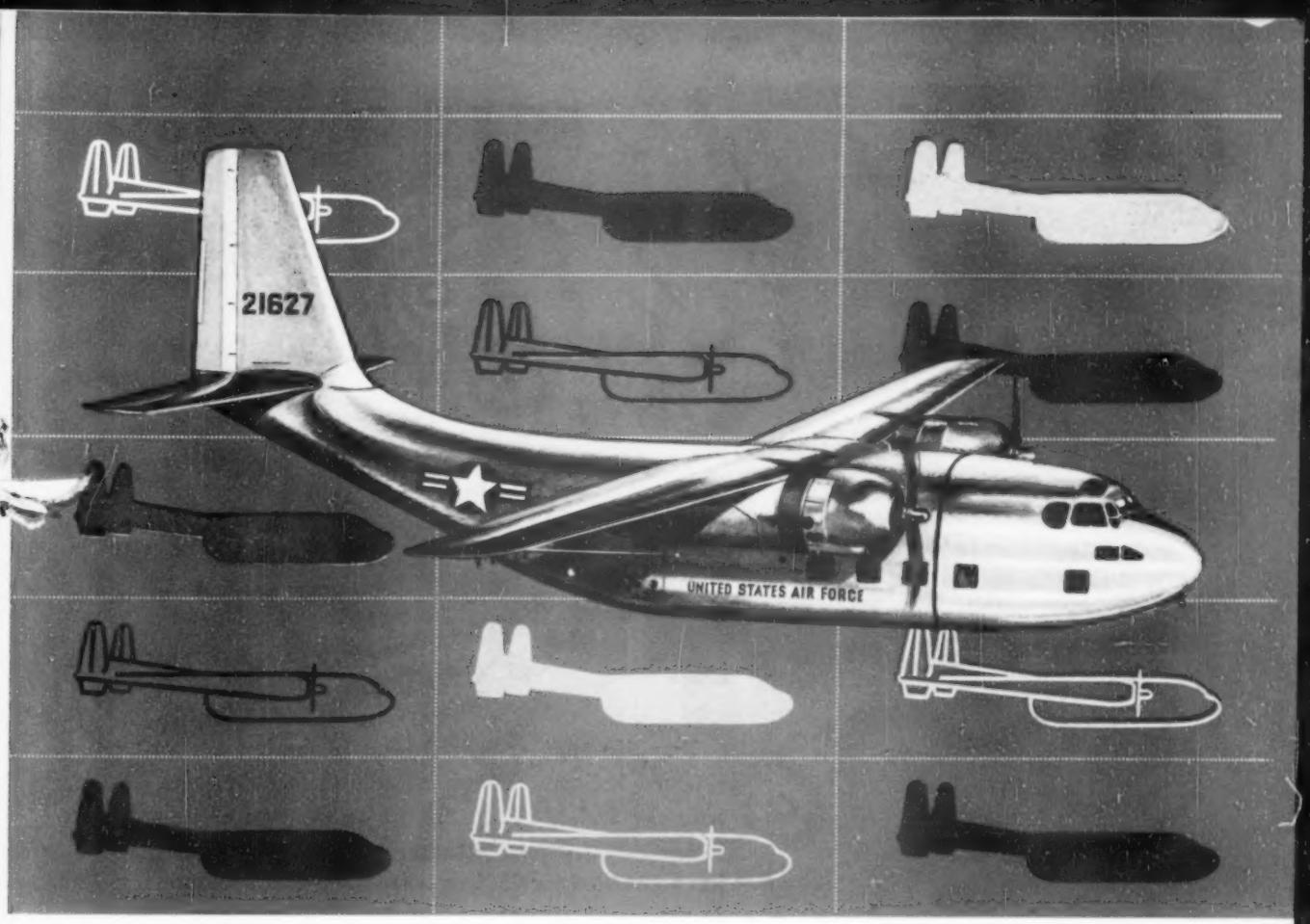


# FLYING BOXCAR AND AVITRUC TEAMED FOR MILITARY AIR TRANSPORTATION!

Close to full-scale production at Fairchild — the new C-123 Assault Transport will fill specialized military requirements for an air transport sufficiently versatile to deliver men or equipment at advanced bases. This sturdy craft readily converts from a carrier of 60 fully equipped combat troops to a cargo plane delivering more than 15 tons of equipment.

Continuing quantity production of the combat proven C-119 Flying Boxcar assures the nation that our military transport program is completely flexible. This dual production brings closer the day when C-119's and C-123's will be in regular use as a part of the U. S. Air Force and U. S. Army military operations.

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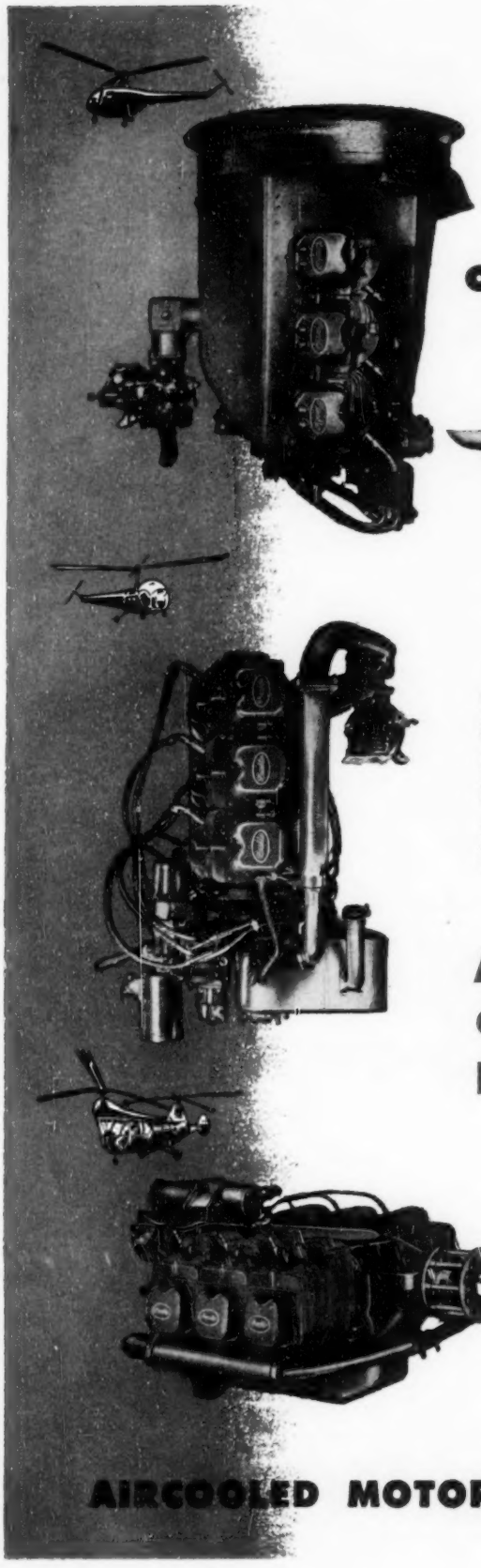

# 75%

## of all the helicopters flying today have

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## POWER

Franklin engines power 4 out of the 5 CAA certificated helicopters under 400 h. p. — Bell, Hiller, Sikorsky and McCulloch. The production of these four manufacturers in the under 400 h. p. category has accounted for 75% or more of all the helicopters in the world, all powered by Franklin engines made by Aircooled Motors, Inc.

## Aircooled Motors is also a major subcontractor of precision machining

The same men and plant responsible for the extraordinary success of Franklin helicopter engines can accept additional subcontract work similar to that long produced for major companies in the aircraft field. We are fully equipped for quantity production of precision machining and subassemblies of the highest quality. Your inquiries are invited.

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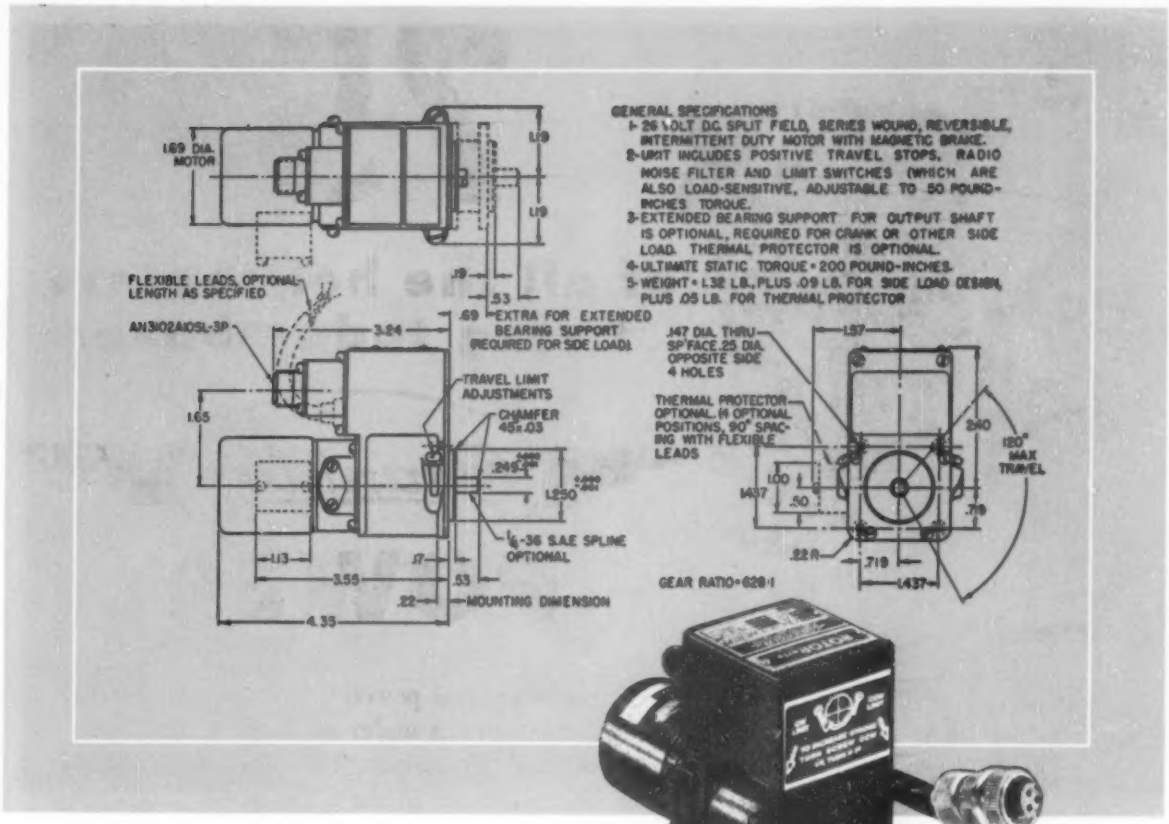
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4- ULTIMATE STATIC TORQUE = 200 POUND-INCHES.
5- WEIGHT = 1.32 LB., PLUS .09 LB. FOR SIDE LOAD DESIGN, PLUS .05 LB. FOR THERMAL PROTECTOR
1.69 DIA. MOTOR
FLEXIBLE LEADS, OPTIONAL LENGTH AS SPECIFIED
AN3102A10SL-3P
3.24
.69 EXTRA FOR EXTENDED BEARING SUPPORT REQUIRED FOR SIDE LOAD
TRAVEL LIMIT ADJUSTMENTS
CHAMFER 45° x .03
1.65
.245
1.250
¼-36 S.A.E. SPLINE OPTIONAL
.113
.17
3.55
.53
.22
MOUNTING DIMENSION
4.35
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THERMAL PROTECTOR OPTIONAL IN OPTIONAL POSITIONS, 90° SPACING WITH FLEXIBLE LEADS
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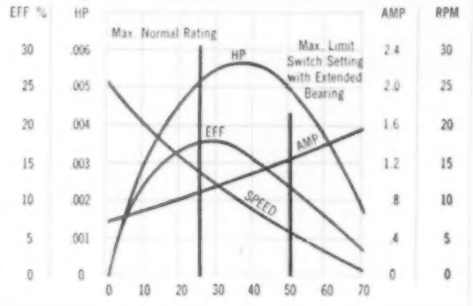
Model R-430
ROTORette

# THE ACTUATOR THAT KNOWS WHEN TO STOP

Once the original limits are set, this compact rotary actuator actually "senses" the additional load imposed by running against the adjustable stops, and halts automatically. This load-sensing feature, plus the positive stops, eliminates over-travel completely. These features have attracted the attention of such leaders as Grumman, McDonnell, Lockheed, North American, Republic, Fairchild, A. V. Roe, and Piasecki—all of them now large-scale ROTORette users.

***Model R-430 performance curve at 26 volts D.C.***

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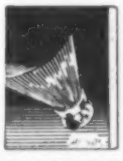

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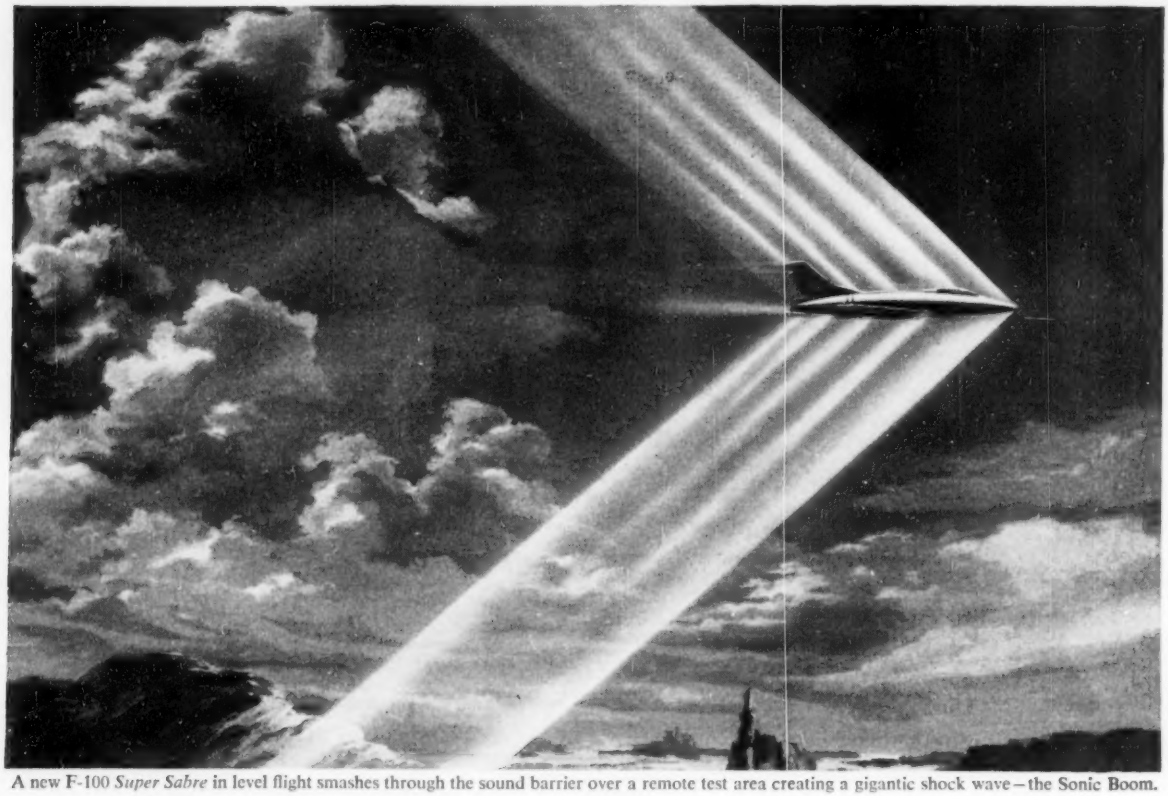

A new F-100 *Super Sabre* in level flight smashes through the sound barrier over a remote test area creating a gigantic shock wave—the Sonic Boom.

# SONIC BOOM!

## THUNDERING SIGNAL OF AVIATION'S PROGRESS FOR NATIONAL DEFENSE

Called "mysterious thunder" when first heard, Sonic Booms have demonstrated to Mr. Average Citizen the fact that we have entered the era of everyday supersonic flight. The mere idea that an airplane flying through the air can produce a sound "like thunder on a clear day" may seem fantastic. Actually a Sonic Boom is a perfectly natural occurrence . . . a sort of gargantuan "pop" . . . brought about by a jet plane flying faster than sound. Very much like waves made by a motorboat on a lake . . . a jet creates gigantic shock waves in the air . . . so immense, that when they reach us on the ground, they sound like thunder or a rumbling explosion.

Once a surprising new sound . . . the cause of Sonic Booms is now understood, and positive steps minimize the probability of Booms over our homes. For instance, North American began early testing at supersonic speeds over remote areas. These experiments have led to rigid control of all flights. Today, the aircraft industry and the Armed Forces prevent disturbing Booms by making supersonic flights at extreme altitude or away from our cities and towns.

While you read these words, planes designed and built by North American . . . like the F-86 *Sabre* Jet and the new F-100 *Super Sabre*—America's first operational fighter to fly at supersonic speeds in level or climbing flight—fly vital defense missions without disturbing your daily life.

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*organization, facilities and experience keep*

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# THAN ANY OTHER SOLENOID VALVE MADE

The new VALCOR V-3900 is unique. The exceptional operating advantages of the VALCOR *floating seal* design has been improved even further . . .

**New ruggedness at ½ the weight**
**New compactness at ½ the weight**
**New dependability at ½ the weight**

**Yet the same flow capacity as the V-200-12A.**

This remarkable achievement means a greater freedom of design for the engineer than ever before. The VALCOR V-3900 is setting new standards of Solenoid Valve performance where low pressure drop and lightweight are a factor.

*WRITE FOR DETAILED INFORMATION*

VALCOR
SOLENOID VALVES

Design Features of the Valcor V-3900 Shut-Off Valve

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- Absolute Minimum pressure drop. Straight-through flow.
- Valcor Floating Seal (Gate Type)
- Simplicity of design
- 100% efficient seal in both directions
- Self lapping—self cleaning
- IMPROVED SOLENOID COIL—CONSTANT DUTY withstands shock, vibration and the elements.

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Operating voltage—18 to 30 V.D.C.
Current Drain—½ AMP @ 24 V.D.C.
Max. Operating Press.—100 PSI
Porting—AND10050-4
Other port sizes available either normally open or normally closed. Designed to conform to latest military specifications. Pat. Pend.

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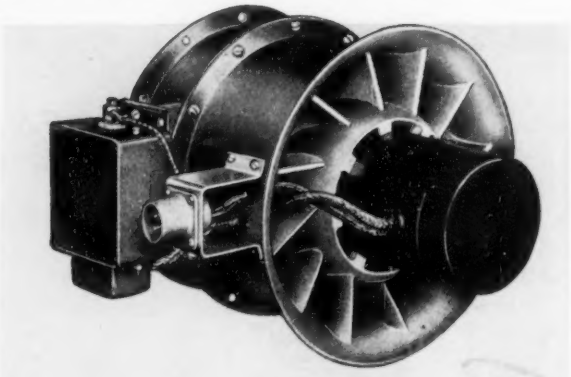
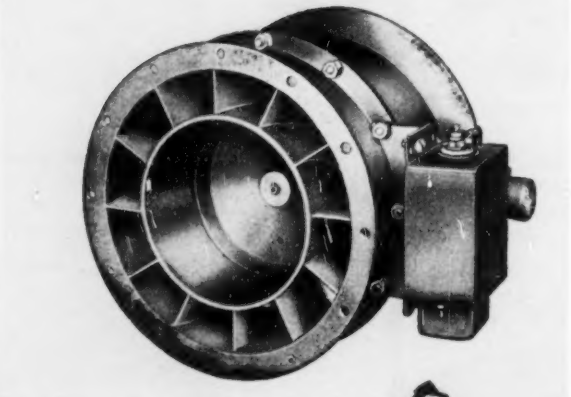
**VALCOR ENGINEERING CORP., CARNEGIE AVE., KENILWORTH, N. J.**

# A Breeze from JOY AXIVANE® AIRCRAFT FANS





The North American B-45 "Tornado" Bomber, like most U. S. aircraft, has many features designed solely for the flight personnel's comfort.

Acting on the logical assumption that a more comfortable pilot is a better pilot, North American engineers called for a cockpit-cooling system of Joy Axivane Fans to keep the flight personnel from melting while waiting for take-off on hot days. When the "Tornado" is airborne, the fans are used in conjunction with a heating system to furnish warm air for canopy defrosting. On the RB-45 photo-reconnaisance bomber, the same fans also keep the camera ports free from frost or fog.

The versatility of this system is largely dependent upon that of the Joy AXIVANE Fan. The fans used on the B-45A, B-45C, and RB-45C provide 250 CFM at 6.5" W.G., yet they are only 6.5" in diameter and weigh but 9 lbs.

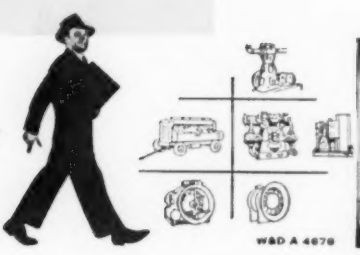
● Joy designs and builds each fan to the exact requirements for which it is intended. Each fan, therefore, is custom-engineered for highest efficiency. For many purposes stock fans can be supplied from the extensive line already designed. Both single and two-stage units available. Optional features include straight or flared inlets, beaded or flanged connections, radio noise-filters, anodization, and cooled motors where required.

★ ★ ★ ★ ★

Here are some of the many uses for JOY AXIVANE Aircraft fans: Windshield de-frosting, windshield or wing de-icing, cabin heating, cabin ventilating, cockpit heating, cooling radio and electronic equipment, cooling voltage regulators, oil cooling, gear-box cooling, instrument cooling, air recirculation, and high-altitude pressurizer boosting. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.,*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

*Consult a Joy Engineer*

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators



W&D A 4670

JOY

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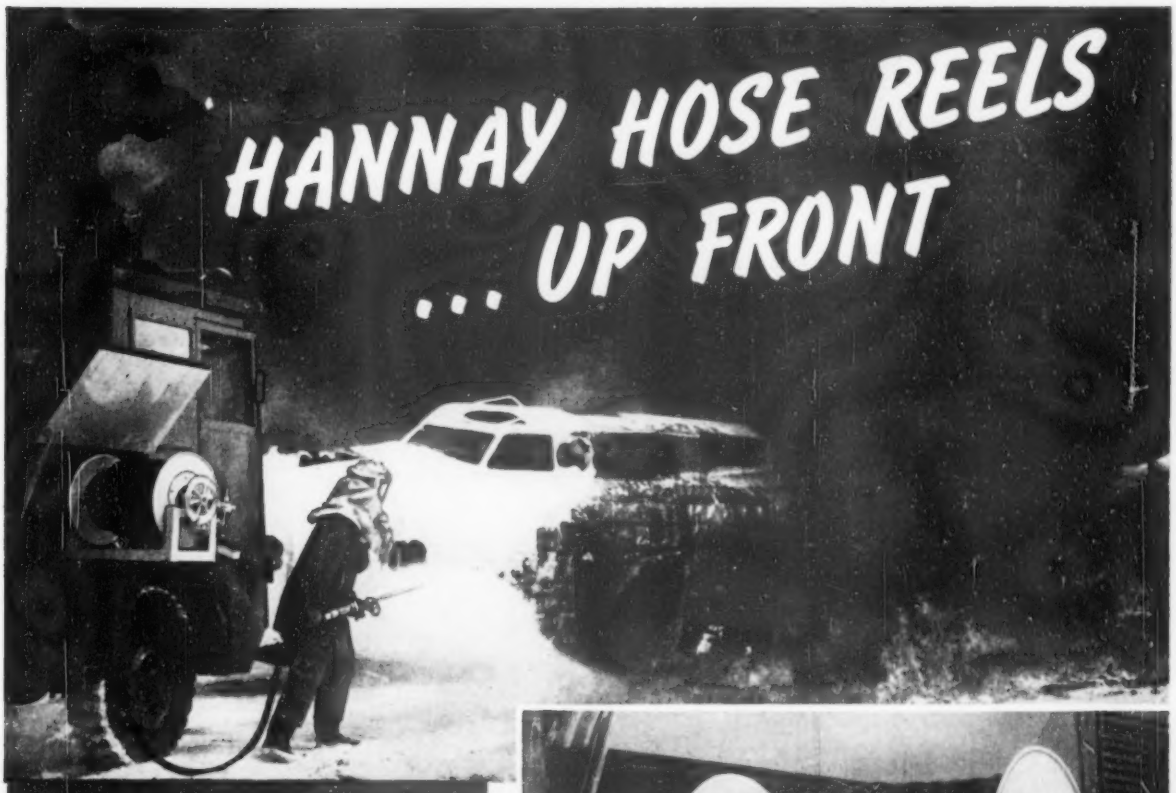
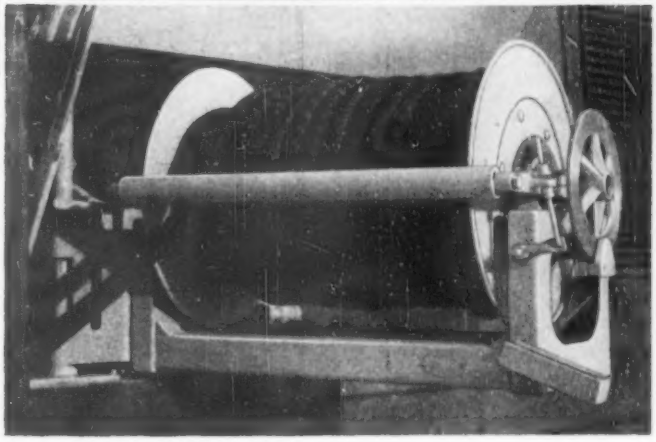
# HANNAY HOSE REELS ... UP FRONT





Yes . . . in performance and service, Hannay Hose Reels are "up front". The dramatic illustration above shows Air Force Fire Fighters spraying foam from a new American LaFrance crash truck on burning aircraft. And the reel, of course, is a Hannay, specially designed for military service. When YOU need good hose reels, standard or special performance, remember HANNAY. . . . built to do a BETTER job, in fire-fighting, in industry, in national defense.

...LOOK FOR THIS

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HOSE REELS
CLIFFORD B. HANNAY & SON, INC.
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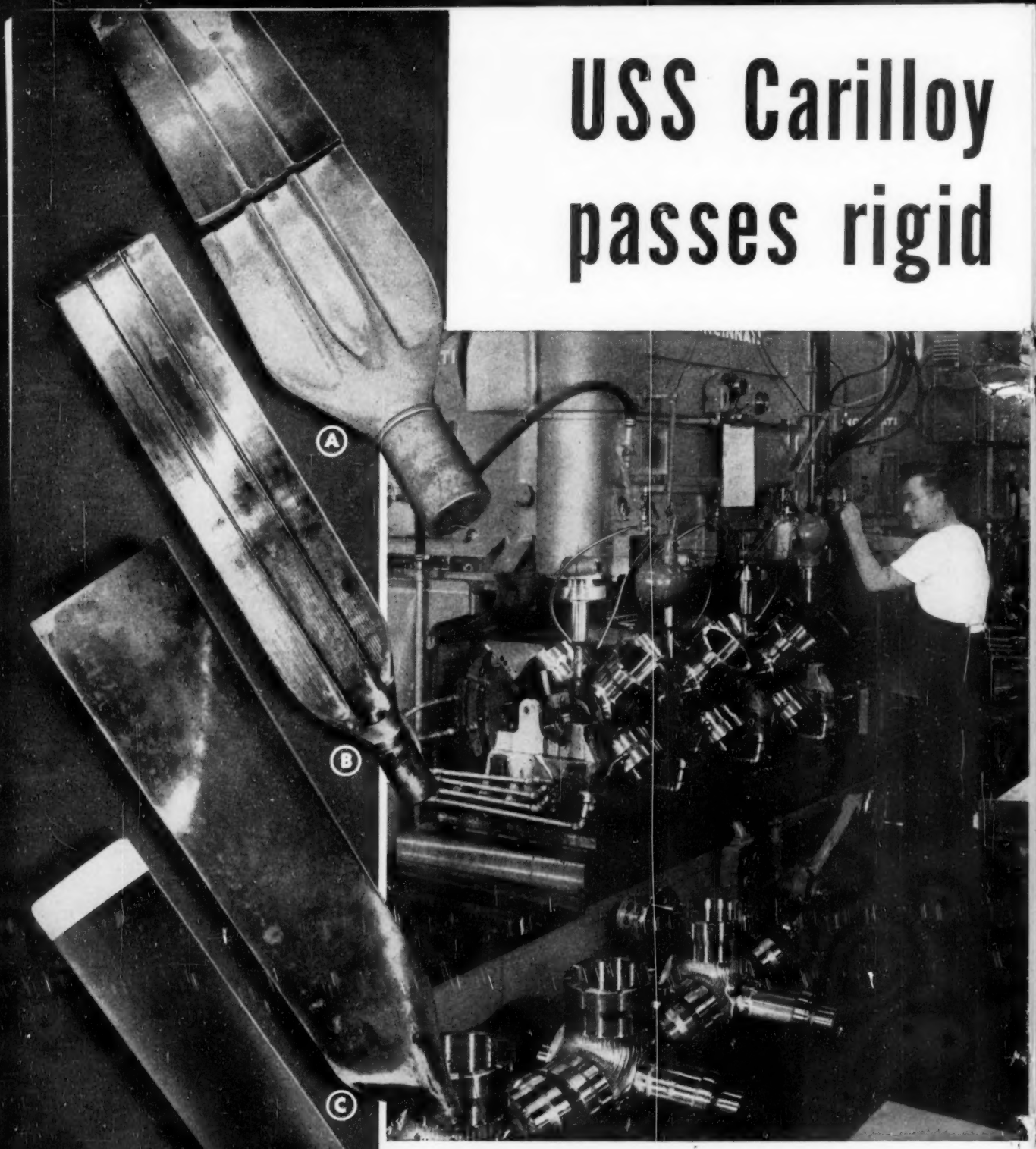



**THESE HIGH QUALITY** aircraft propeller hubs are forged and machined from semi-finished Carilloy 4340. They meet extremely tough magnaflux requirements.

**FOR BIG PROPELLERS,** 2 forged sections (**a**) are welded together to form one blade thrust member. Pieces are then ground and magnafluxed. Kellered, ground, and magnafluxed again (**b**). Mill camber sheets (**c**) then are copper brazed to the thrust members. Entire unit is heat treated and polished before final magnaflux test and cadmium plating. Rigorous magnaflux testing assures that every finished blade (**d**) can withstand the tremendous stresses encountered on the latest high-speed planes.

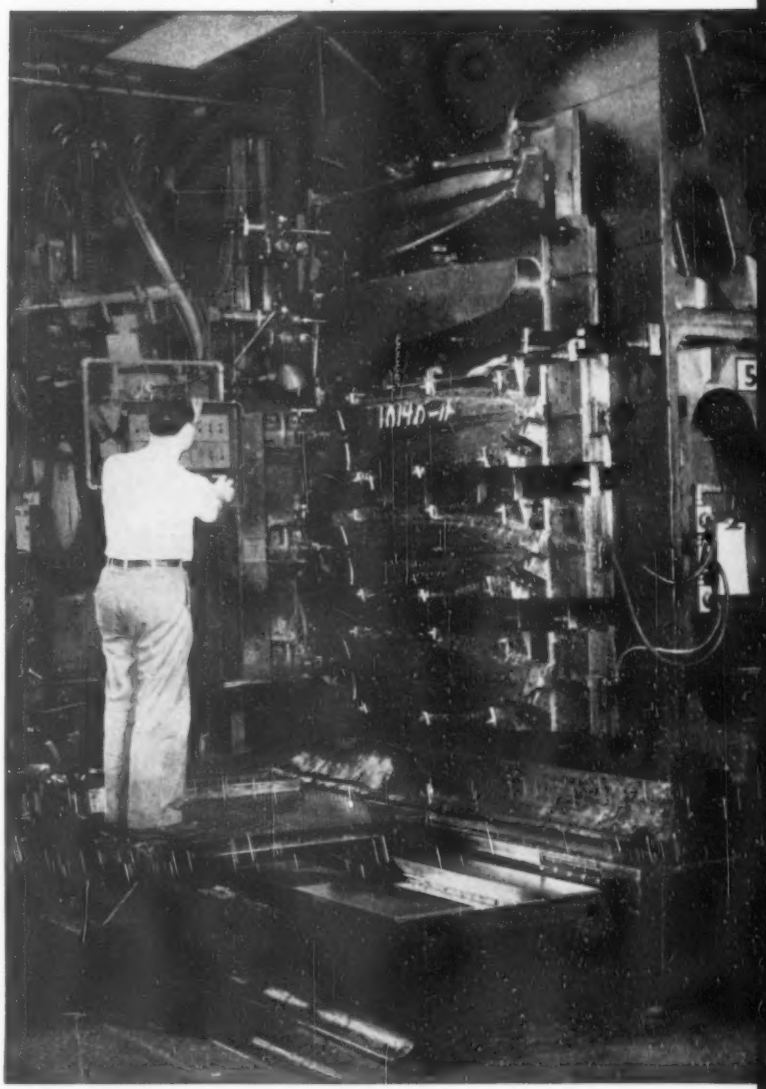
# steel tests for propeller blades

AN important manufacturer of propellers for military aircraft has found that in stringent magnaflux tests, USS Carilloy steel performs completely satisfactorily.

The high stresses in propeller blades and hubs naturally require extremely high quality steels. Accordingly, the U.S. Army and U.S. Navy have set up rigid quality specifications requiring that every heavily stressed part must be magnafluxed several times during its production.

With USS Carilloy 4340 electric furnace aircraft quality steel, this important manufacturer is able to count on the performance required for this severe application. The consistent high quality of USS Carilloy aircraft steel has meant greater savings to this customer through minimum magnaflux rejections of costly fabricated parts.

USS Carilloy steels have established an enviable record for meeting the highest quality requirements. Therefore, when you need a standard AISI analysis or a special steel for an unusual application, it pays to call in a USS Service Metallurgist. He can help you solve any steel problem.



**AFTER FORGING AND MILLING,** 750-lb. thrust sections are hogged out on this Kellering Machine. Finished sections weigh about 155 lbs. USS Carilloy steel maintains a No. 1 quality position on these heavy-duty parts.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

## Carilloy USS Steels

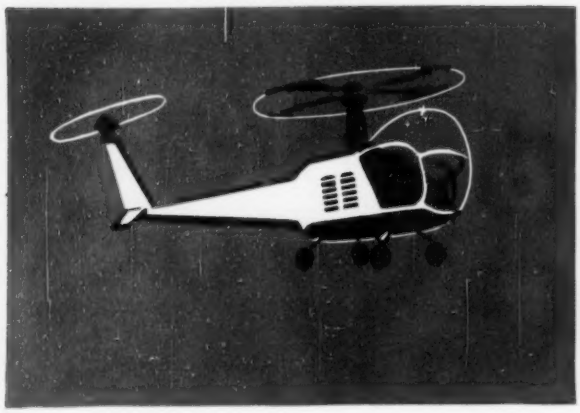
ELECTRIC FURNACE OR OPEN HEARTH

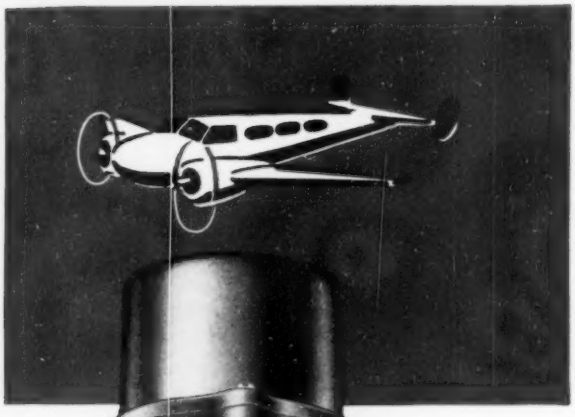
COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

6-6875

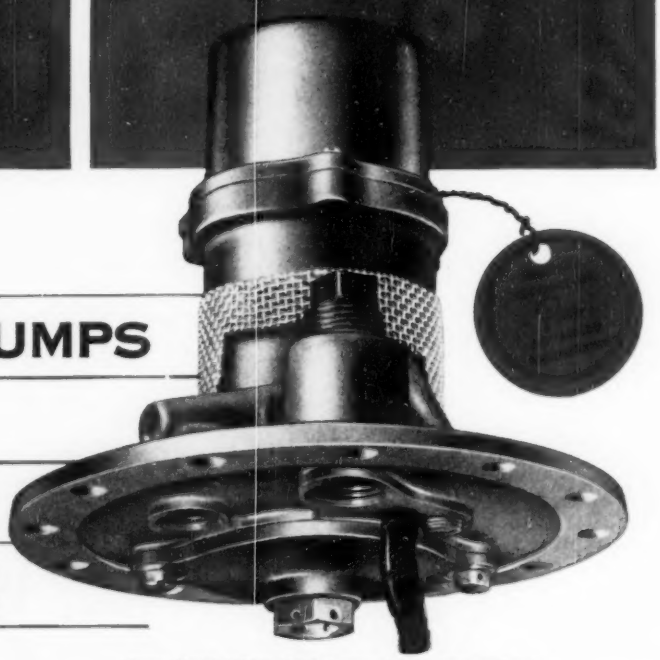
UNITED STATES STEEL

**ON HELICOPTERS...** **OR EXECUTIVE AIRCRAFT...**





# HERE ARE DEPENDABLE PUMPS ADAPTABLE TO MANY REQUIREMENTS



Pesco Model 122723-100 Submerged Fuel Booster Pump. Rated output of basic model 300 pounds per hour at 10.3 psi at 27 volts, 2.8 amps. Modified models for short life requirements are capable of flow of 1,300 pounds per hour at 10 psi at 27 volts, 5 amps. Weight approximately 3 pounds.

Performance requirements for aircraft are the most exacting we have today . . . and Pesco has contributed greatly to dependable aircraft performance through advanced engineering and precision production of fuel and hydraulic pumps.

Typical of these is the Pesco line of small Fuel Booster Pumps which incorporate several important advantages for all aircraft applications.

First is their great flexibility. As an example of this flexibility, the model illustrated was designed basically to pump 300 pounds per hour at 10.3 psi. Slight modifications provide pumping at rates *as high as 1,300 pounds per hour*—with the same constant pressures!

Second, all Pesco submerged fuel booster pumps are driven by motors designed and built by Pesco. This single responsibility of design and manufacture insures full coordination for optimum performance.

Pesco fuel booster pumps have proved their exceptionally high performance and dependability in thousands of installations on military, commercial, and civilian aircraft of all types.

Pesco's complete line of small sized booster pumps for executive airplanes, helicopters, trainers, target drones, etc., provides *advanced* equipment to meet your future requirements.

*Call or write the Home Office, Bedford, Ohio for full information on these Pesco products as applied to your specific installation.*

**HYDRAULIC PUMPS • BOOSTER PUMPS • FUEL PUMPS**
**AIR PUMPS • ELECTRIC MOTORS • POWER PACKAGES**

engineering Pesco production
**PRODUCTS DIVISION**

**BORG-WARNER CORPORATION**
24700 NORTH MILES ROAD • BEDFORD, OHIO

The main transmission of this Hiller HTE-2, made by **WESTERN GEAR WORKS,** uses Timken bearings on the shafts of the gear train to assure dependability and long life.

# Entire weight of Hiller helicopter hangs by TIMKEN® bearings

THREE lives, plus this Navy HTE-2 Hiller helicopter itself, depend on Timken® tapered roller bearings. In the air, the whirlybird hangs onto its rotor blade shafts with Timken bearings in the main and tail rotor gear box. The drive unit featured above, made by Western Gear Works, uses Timken tapered roller bearings to assure dependability and long life.

The tapered construction of Timken bearings enables them to take radial and thrust loads in any combination. As a result, Timken bearings on the rotor shaft absorb the heavy thrust-weight load of the 'copter and pilots. At the same time, they easily handle the radial load imposed by the rotor shaft as it whirls at 338 rpm.

Because of their tapered construction, Timken bearings hold the rotor shaft in positive alignment. This insures accurate meshing of the drive gears, minimizes wear on gears themselves. And full line contact between rollers and races gives Timken bearings extra load carrying capacity.

To get dependability like this in the equipment you build or buy, specify Timken bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

*This symbol on a product means its bearings are the best.*

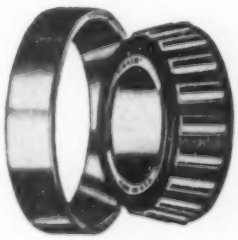
**WE MAKE OUR OWN STEEL**

The special grade alloy steel which gives Timken bearings their strength and resistance to wear is made in our own steel mills.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ┼ AND THRUST ⊣○⊢ LOADS OR ANY COMBINATION

# PLEXIGLAS...aviation's standard

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# transparent plastic

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# We've Whipped TD*!

**TD Proofed Servo Motors**

**. . . Another Flight-Improving First**

by **Greenleaf.. WHERE QUALITY CONTROL WORKS ON THE PRODUCTION LINE**

* ***TD MEANS*** *TORQUE DECAY. TD in a single servo loop can keep an airplane grounded for hours, even days. TD is like Cancer in the human body. It is the gradual merciless wasting away of torque due to internal changes of components in a servo motor. It shortens life, destroys accuracy, ends efficiency.*

## New Life for Servo Motors

Now Greenleaf offers you servo motors that are TD-proofed. Actually, Greenleaf methods and ingenuity have reduced TD by as much as 1500%. This is true for *all* Greenleaf electro-magnetic rotating devices.

This is another example that shows why Greenleaf is regularly selected as a prime or sub-contractor by the following: U.S. Air Force, U.S. Navy, McDonnell Aircraft, Boeing, Emerson Electric Company, Eastman Kodak, Avco Mfg. Corporation and other leading organizations.

See our exhibit at the National Aircraft Show, Dayton, Ohio, Sept. 4, 5 & 6, 1954.

See Greenleaf for Servo Motors and for Gyros, Pressure Transmitters, Accelerometers, Synchros, Air Speed Indicators, Actuators and other precision units and components.

*Engineering*
*Development*
*Production*

THE Greenleaf.. MANUFACTURING COMPANY

7814 Maplewood Industrial Court • St. Louis 17, Missouri

# Carrier Based Jets to have Radar Guided Missiles

NAVY'S AIR-TO-AIR SPARROW 1 IN PRODUCTION

**THE STORY BEHIND THE STORY:**

■ On May 12, newspapers from coast to coast carried headlines like the ones above, announcing the Navy's newest weapon of defense—Sparrow I—and the beginning of volume production for operational use in the fleets.

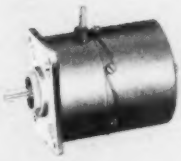
■ Ahead of these headlines were 7 years of intensive cooperative effort shared by the Navy's Bureau of Aeronautics and Sperry.

■ Originally designated project HOT SHOT, Sparrow began back in 1947 when the Bureau of Aeronautics assigned to Sperry the full responsibility of creating an entirely new air-to-air missile system. It had to be light and compact – so multiple units could be carried by fighter-type jets. It had to be deadly accurate – capable of outmaneuvering the swiftest bombers an enemy could produce. And it had to be practical—suitable for large-scale production.

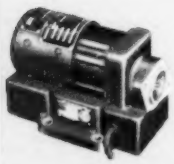
■ The rocket-powered, radar-guided Sparrow I, coming off the production lines here and at the new Sperry Farragut plant in Bristol, Tennessee, meets these requirements—and more. It embodies the proved features of more than 100 different missiles designed, constructed and tested during a 7-year period – and the finest brains of an organization that has devoted more than 40 years creating and manufacturing automatic flight control and fire control systems.

SPERRY GYROSCOPE COMPANY

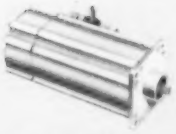
DIVISION OF THE SPERRY CORPORATION • GREAT NECK, N.Y.



Fast action clutch-brake of unique Lear design utilizing two opposing coils to force clutching and declutching. Increases the speed of both operations. Typical application: digital mechanical computor.

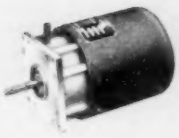


Specially designed Lear motor utilizing offset gear train to allow close tolerance between mounting surface and output shaft. Typical application: aircraft scavenger pump.

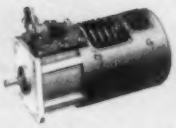


Lear intermittent duty AC motor. Has high torque AC brake capable of stopping both rotor and connected inertia load. Typical application: positioning actuator for jet engine air intake doors.

Lear AC brake motor with exceptional environmental resistance. Non-corrosive materials used throughout, including laminations. Typical application: aileron trim tab actuation.

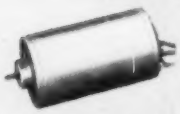


AC motor of the air-over-totally-enclosed type. Has special mylar high dielectric insulation. Typical application: hydraulic pumps.



Synchronous AC motor. Has exceptional high starting torque which overcomes starting drag characteristics. Provides optimum low temperature operation. Typical application: radar scanning device.

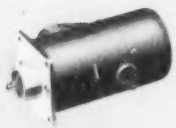
DC intermittent duty motor incorporating Lear Fastop Clutch. Extensively used for heavy duty. Typical application: cowl flap power unit.



Miniature DC motor. Unusual specifications required armature which could be stalled continuously and a field to match 10,000 ohm impedance of vacuum tube amplifier. Typical application: trim tab servo.

Lear DC motor with noise filter designed integrally into special pump base. Totally enclosed and self-ventilated. Typical application: pumps.

Gearhead DC motor. Demonstrates building block flexibility. Gearhead components are available in a variety of gear ratios for all Lear motors. Typical application: guided missile fin actuation.



DC brake motor with quick stopping and high holding torque. Optional thermal protection. Typical application: seat actuator.

# Motors by the Million

*...and all of aircraft quality!*

Although Lear's production of electric aircraft motors impresses by its magnitude, the major emphasis is first, last, and always upon ***quality.*** It is doubtful that any other company invests as much engineering time into every motor it builds. An entire, top-calibre engineering department is devoted exclusively to motor design, making Lear exceptionally qualified to handle the more exacting and difficult applications which most manufacturers hesitate to tackle.

Lear's excellent ***facilities*** for the design, engineering, production, and testing of motors are devoted to building *aircraft* motors and aircraft motors alone. Lear motors are designed to meet every applicable military specification.

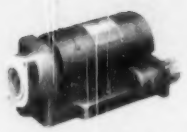
Lear has accumulated immense ***experience*** in the manufacture of motors of aircraft quality, having built over one million since 1941. All motors used on precision Lear equipment such as electro-mechanical actuators, vertical gyro indicator systems, and F-5 autopilots, are Lear motors, so they *have* to be good.

Lear is an acknowledged leader in the field of motor noise ***filtering.*** Noise filters are engineered into Lear motors at the design stage—not added as an afterthought when the product is finished—thus providing substantial savings in weight and space, and tangible bonuses in performance.

Lear motors achieved early prominence through the use of the Lear "Fastop" clutch, and are now available with a complete line of ***braking*** devices, including both AC and DC brakes of the single-disk and multiple-disk types (which incidentally, are offered as separate components to other manufacturers).

Although all Lear motors are new ***designs,*** an infinite variety of additional models are available through combination of arrangements used in our regular families of motors, of which only a small part are illustrated here. Thus, Lear-quality models can be designed, and are designed, to meet practically any specialized requirement.

If you need any kind of an aircraft electrical motor—and if you want the best—it will pay you to consult Lear. Write, wire, or phone your nearest Lear Sales Office or Lear, Inc., 110 Ionia Avenue, Grand Rapids 2, Michigan.



Gearhead DC motor. Continuous duty, air-over-totally-enclosed type with single stage reduction spur gearing and built-in filter. Typical application: aircraft fuel pump.

**LEAR** GRAND RAPIDS DIVISION

EM-5

Wash., D.C.: 1701 K St., N.W. • San Diego: 429 Robinson Ave. • Dayton: 53 Park Ave. • Seattle: Term'l Bldg., Boeing Field • Toronto, Ont. and Montreal, P.Q.: Railway & Power Engr. Corp., Ltd.

connections simplified

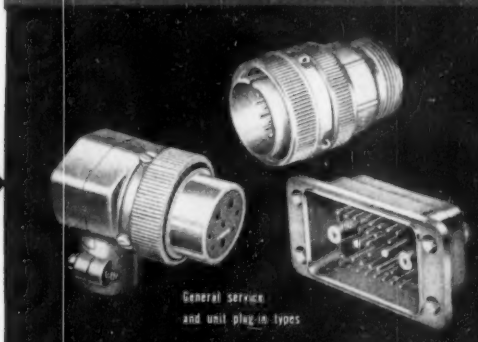
For low level sound applications.

Breakaway connector for instrument testing and control circuitry of guided missiles prior to launching.

For aircraft engine starting, commercial storage batteries, and stationary engine applications.

Sub-miniatures. Same number of contacts as in a standard connector, but in ½ to ⅓ the space.

Miniatures.
For radio, control, instrument uses, etc.



General service and unit plug-in types

Hermetically sealed AN and K type connectors. Miniatures and sub-miniatures.

Special K connectors for TV cameras.

Water-tight and weather-proof connectors for rugged service.

Heavy-duty AO type, originally designed for U.S. Army Ordnance. Adaptable to commercial use. Resilient insulation. Special assemblies.

Greatest variety of firewall and high-temperature connectors.

Also—power plugs and receptacles for a wide range of applications.

*first in connectors*

# CANNON PLUGS

Please refer to Dept. 110

CANNON ELECTRIC COMPANY,
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Factories in Los Angeles, East Haven, Toronto, Canada; London, England. Contact our representatives and distributors in all principal cities of the U. S. A.

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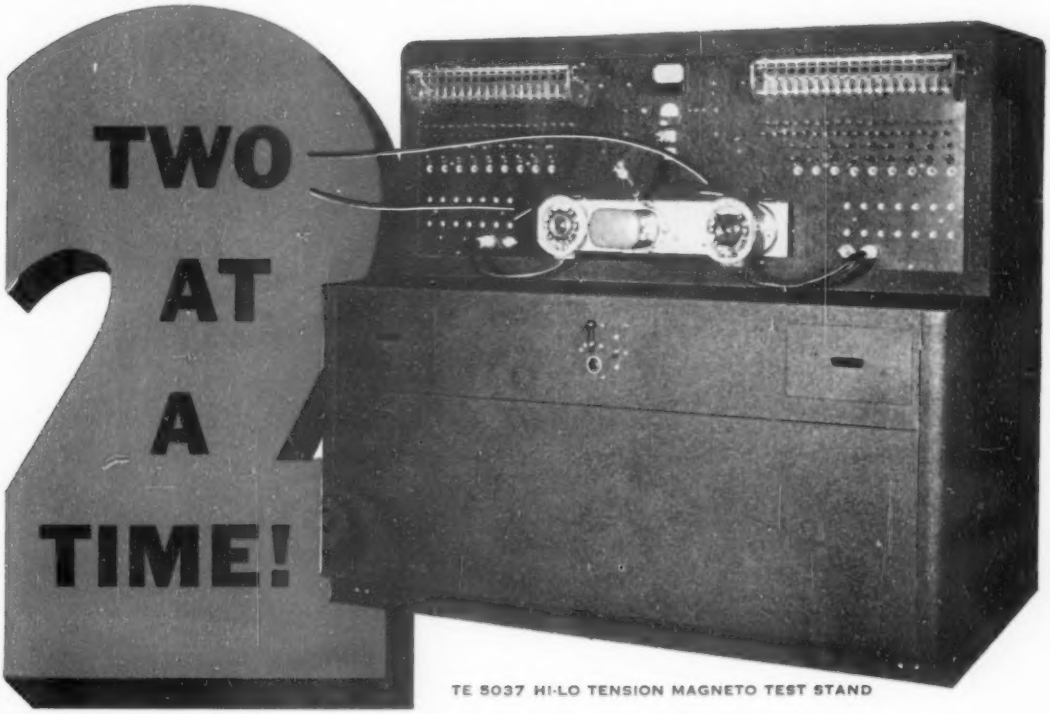
# TEST ANY MAGNETO

## R-985 to R-4360...hi- or lo-tension




TE 5037 HI-LO TENSION MAGNETO TEST STAND

Here's savings spelled out in dollars! Here's *one* test stand that will replace a whole shop full of miscellaneous magneto test units. *In pairs* or singly, you can test *any* magneto regardless of size...test *any* magneto whether high tension or low tension!

Finger-tip controls...handy work table area...amazing freedom from vibration... PAC's famous built-to-take-it easy maintenance construction! Modernize with a TE 5037 Hi-Lo Tension Magneto Test Stand now! You'll speed up every magneto job, you'll save money and valuable shop space, too!

**Test and Handling Equipment Division**

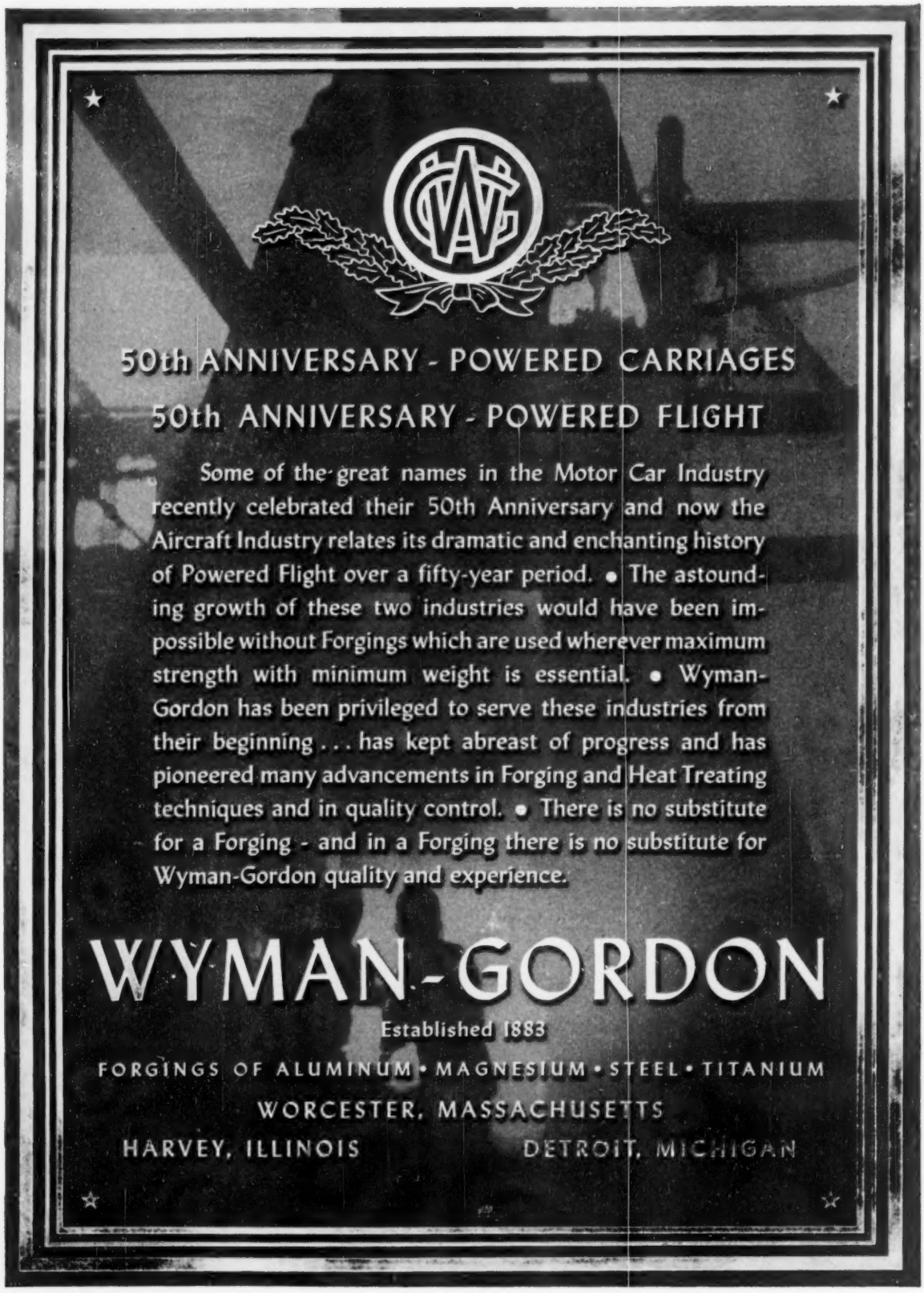
Dimensions: 5' 7½" high; 3½' wide; 6½' long.
Shipping weight approximately 1200 pounds.

**Write for PAC's new Equipment brochure. It describes test and ground handling equipment that has the whole industry talking!**

# Pacific Airmotive Corporation

*Other Divisions: Chino and Oakland, California Seattle, Washington and Kansas City, Kansas*

**2940 N. Hollywood Way, Burbank, Calif.**
**Linden Airport, Linden, New Jersey**


50th ANNIVERSARY - POWERED CARRIAGES
50th ANNIVERSARY - POWERED FLIGHT
Some of the great names in the Motor Car Industry recently celebrated their 50th Anniversary and now the Aircraft Industry relates its dramatic and enchanting history of Powered Flight over a fifty-year period. • The astounding growth of these two industries would have been impossible without Forgings which are used wherever maximum strength with minimum weight is essential. • Wyman-Gordon has been privileged to serve these industries from their beginning . . . has kept abreast of progress and has pioneered many advancements in Forging and Heat Treating techniques and in quality control. • There is no substitute for a Forging - and in a Forging there is no substitute for Wyman-Gordon quality and experience.
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Established 1883
FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS
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To keep pace with the growing need for completely reliable aircraft instrumentation and control components, the Aircraft Products Division of Manning, Maxwell & Moore, Inc. is now manufacturing in three strategic locations: Stratford and Danbury, Connecticut and Inglewood, California.

The expansion and dispersal of our facilities greatly augments the availability of our design, engineering, testing and production facilities. Whether your responsibilities concern the application of aircraft pressure switches, electronic amplifiers, hydraulic valves or turbojet engine control systems, we can now serve you better than ever before. Whatever the dimensional and functional requirements of such vital components, our unique design technique eliminates all compromise with performance. For we recognize that compatibility between airframe and equipment is the key to the success of the weapons system of the U. S. Air Force, as well as the continued leadership of the nation's air transportation industry.

We believe the counsel of our engineering specialists can contribute appreciably to the safety and dependability of today's most advanced aircraft and those you are now developing. Your inquiry is invited.

# MANNING, MAXWELL & MOORE, INC.

**AIRCRAFT PRODUCTS DIVISION • STRATFORD, CONN. • DANBURY, CONN. • INGLEWOOD, CALIF.**

OUR AIRCRAFT PRODUCTS INCLUDE: TURBOJET ENGINE TEMPERATURE CONTROL AMPLIFIERS • ELECTRONIC AMPLIFIERS PRESSURE SWITCHES FOR ROCKETS, JET ENGINE AND AIRFRAME APPLICATIONS • PRESSURE GAUGES THERMOCOUPLES • HYDRAULIC VALVES • JET ENGINE AFTERBURNER CONTROL SYSTEMS.

**350,000 Pound Muscle of the Air Force,** here is the Boeing B-52A Stratofort. First production airplane of the Boeing B-52 Stratofortress series, this plane has a wing span of 185 feet and a length of 156 feet. An undisclosed number of these new bombers will be built for the Air Force in the Seattle plant of Boeing—a leader in commercial aviation and aviation for defense!

## You can depend on Reynolds wherever aluminum serves aviation

The great advances brought about by the aviation industry have resulted in airplanes which fly higher, faster, farther and safer than ever before . . . And Reynolds is proud to say there is Reynolds Aluminum in every type of plane that flies today. A look at the record will show significant contributions by Reynolds to the progress of aviation.

Reynolds quality control, technical services and follow-through fill the material needs and supplement the design and engineering facilities of its customers in many industries.

Let us show you where we can help you cut costs, increase output and make a better product. It will cost you nothing to find out. Simply call our nearest distributor listed under Aluminum in your Classified Directory or write to Reynolds Metals Company, 2559 South Third Street, Louisville 1, Kentucky.

*Free!*

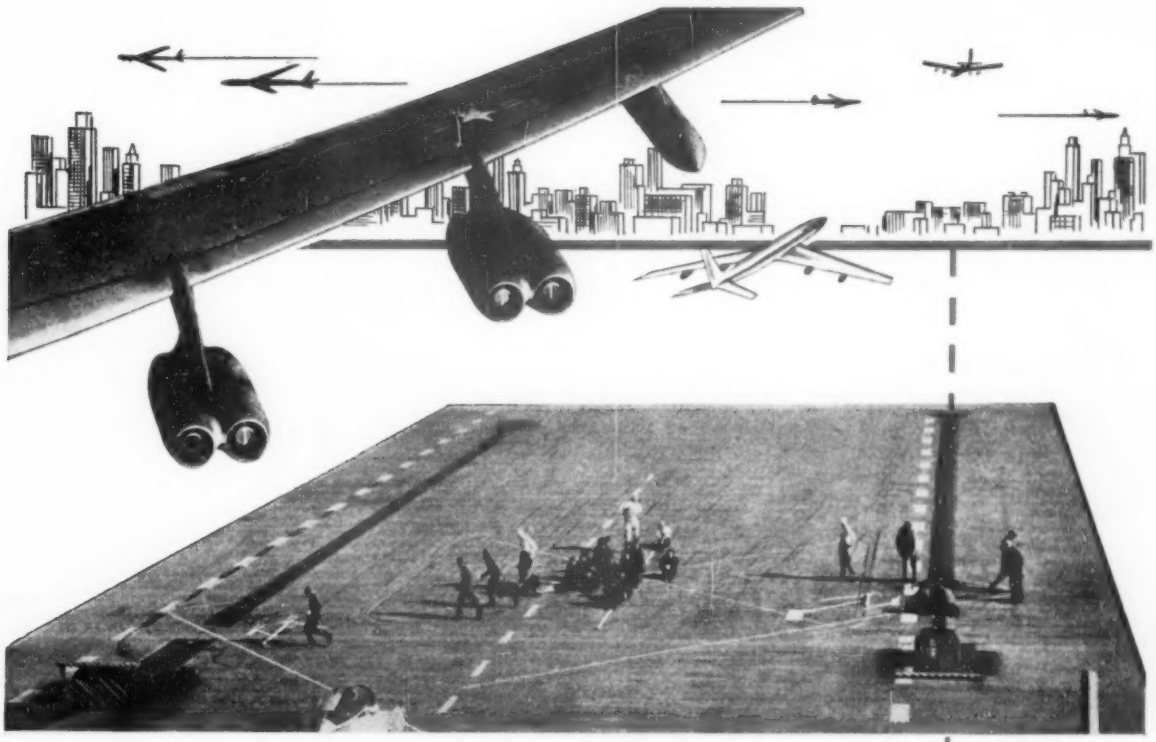
**HELPFUL MATERIALS**

Reynolds technical handbooks are unsurpassed in their field. They can contribute immeasurably to your training program and reference files. Write for a complete index of literature and movies that are available without cost.

See "Mister Peepers", starring Wally Cox, Sundays on NBC TV.

# REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND



# Will the airfield of the future resemble a carrier flight deck?

According to the authorities, it is only a matter of time—perhaps 10 years or so—when launching and recovery systems will be as common a sight on airfields as they are today aboard carriers.

It is to be, for the fields of today are acknowledged to be inadequate for many of the jets on the drawing boards *right now*. Think of the problems this raises—

For the military, increasing the length and strength of runways only adds to their vulnerability.

For commercial interests, construction costs would be prohibitive—even where they were fortunate enough to obtain suitable sites.

Special high energy catapults and modern arresting gear offer one solution to these problems. Such equipment can keep existing fields in use... cut costs when *new fields* are required... maintain present high safety standards.

Bliss personnel are developing launching and recovery systems capable of handling heavier, faster planes. Backed by research and technical know-how, they are ready for the day... that is not too far away... when "land-based" carriers are needed.

**E. W. BLISS Company, Canton, Ohio**

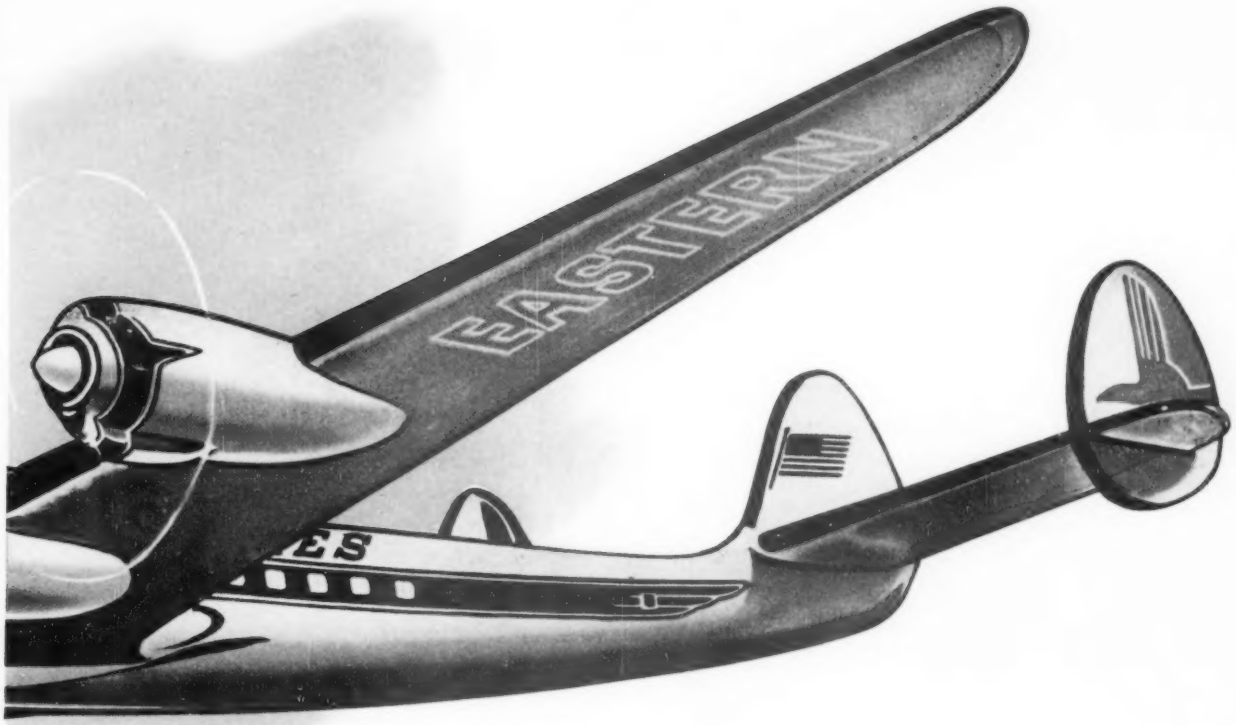
***Presses, Rolling Mills, Can Machinery***

BLISS
SINCE 1857

**CATAPULTS**
**ARRESTING GEAR**
**MACHINE GUNS**
**NAVAL GUN MOUNTS**
**SPECIAL MACHINERY**

# "For Happy Holidays"

## it's EASTERN...




# *For Dependable Engine Lubrication*

## *. . . it's SINCLAIR !*

Flying via Eastern Air Lines means "Happy Holidays" to thousands of vacationists. They rely on the fast, safe service of Eastern's Great Silver Fleet because the proof of its dependability is backed by *billions* of passenger miles. And Eastern helps to maintain these high standards by using the finest products available.

Eastern shows its confidence in Sinclair by using Sinclair Aircraft Oil exclusively for reliable service and maximum protection against engine heat and friction. *Today, more than 45% of the oil used by major scheduled airlines in the U. S. is supplied by Sinclair.* Why not place *your* confidence in Sinclair Aircraft Oil?

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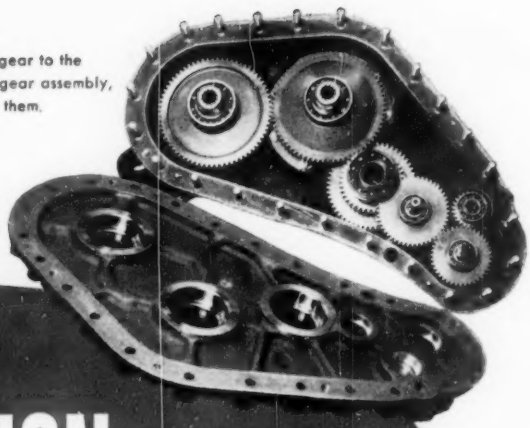
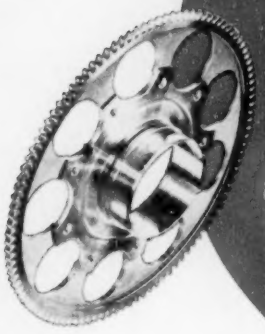
*Sinclair Refining Company, Aviation Sales, 600 Fifth Avenue, New York 20, N. Y.*

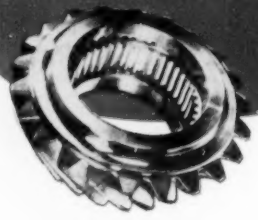
From the simplest gear to the most complicated gear assembly, PRECISION makes them.

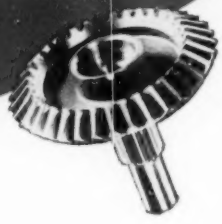


# PRECISION...

## *where it counts*







**Serving aviation with PRECISION products...**

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Pre-ci'-sion... quality or state of being precise, exactness, accuracy*. This definition in its few brief words tells the story of PRECISION GEARS. Our experience and know-how gained in meeting the high degree of precision demanded by modern aviation, can help you solve your gear problems. Consult us on engineering problems or let us quote on your requirements.

*Webster's New Int[illegible] Dictionary

## PRECISION GEARS & PRODUCTS, INC.

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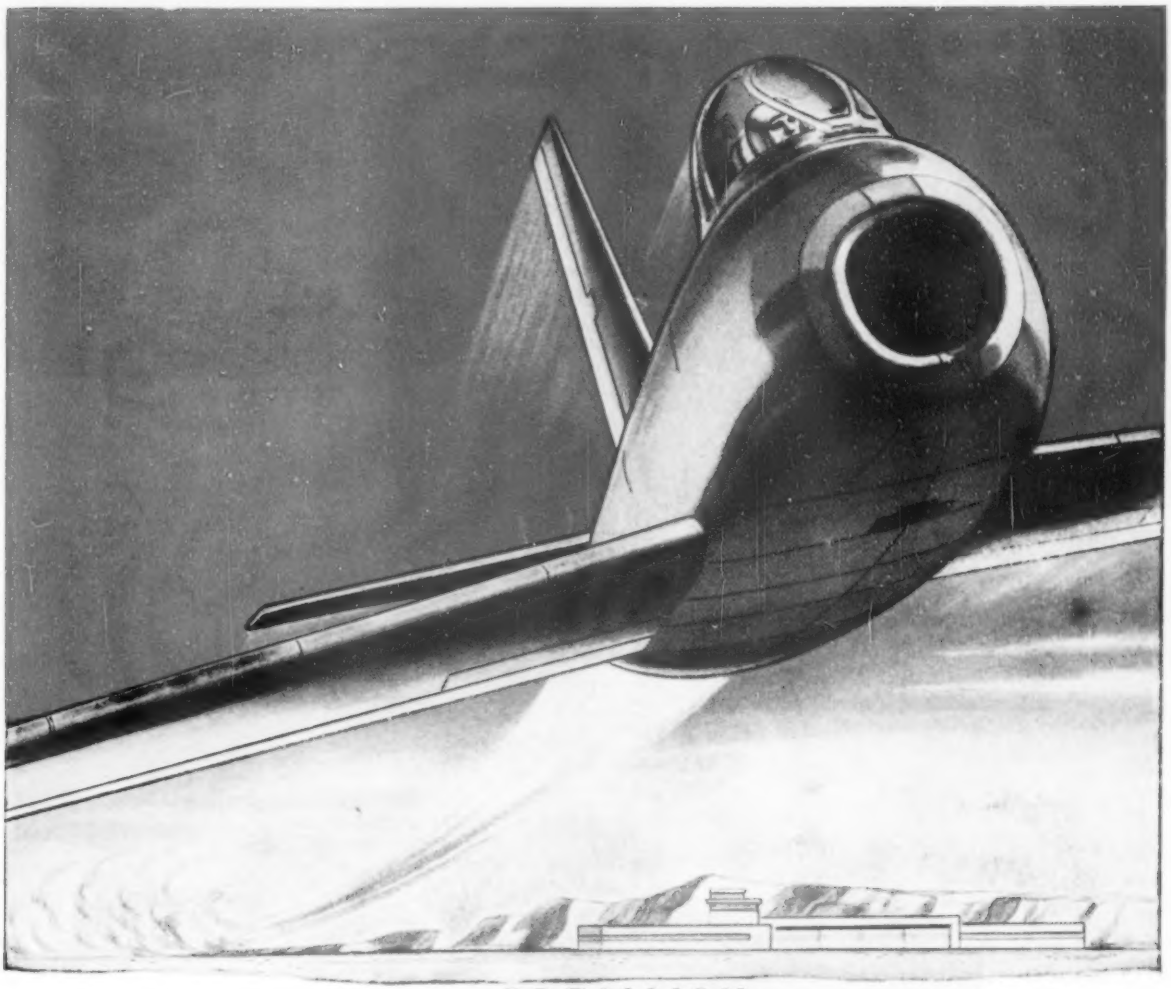

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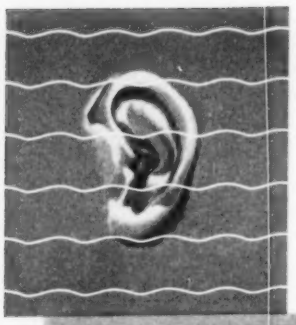


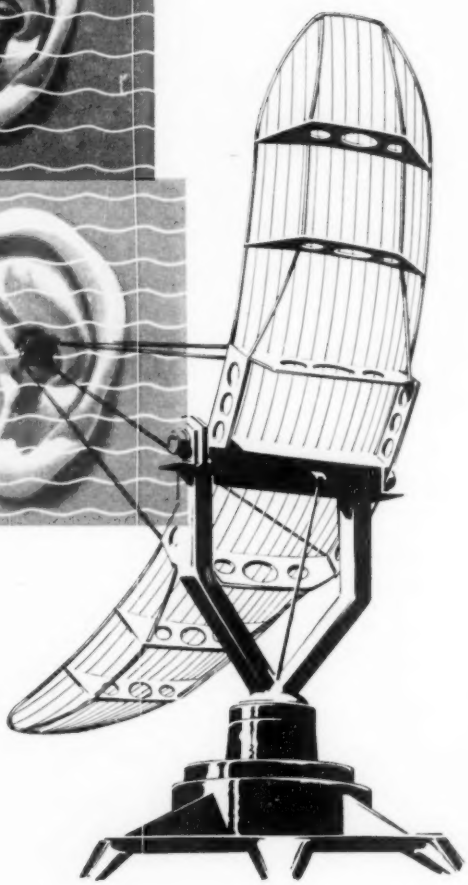
# HEARING AID
## for long range listening

Surprise attack? Not with this vigilant hearing aid to search out the enemy, furnish data to compute distance, height and speed—sound an early warning.

Crosley is developing, designing, building and testing complete radar systems for airborne, shipboard and ground stations—all vigilant hearing aids for long range listening.

And in Crosley's flexible engineering and manufacturing facilities, Military demands meet quick response—prompt deliveries.

"Right and On Time", an illustrated brochure describing Crosley facilities for Military production, is available to Procurement Agencies and defense contractors. Be sure to write for your copy today, on your business letterhead.



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**ENGINEERS:** Constant expansion of long-range research and development defense contracts in electronics, electro-mechanical devices and fire control systems increases opportunities for highly skilled engineers. Contact our Director of Engineering.

# Nothing Missing in the LINK!

Link Hi-Precision Gear Box, one of many in the Flight Simulator, shows the New Departure **ball** bearings that maintain accurate gear pitch-line contact . . . almost entirely eliminate backlash and friction.

Take off . . . rough weather . . . enemy aircraft . . . Link's F-89D Jet Flight Simulator provides nearly every flight situation without getting off the ground. Extensive use of New Departure **ball** bearings throughout assures the same operational characteristics, the same smoothness and accuracy, so essential in actual aircraft equipment.

These high-precision **ball** bearings provide low starting torque, very low running friction and exact location of vital parts, irrespective of operating position.

If you design for aircraft equipment, it *will pay you to talk to your New Departure engineer, today!*

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**BALL BEARINGS**

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
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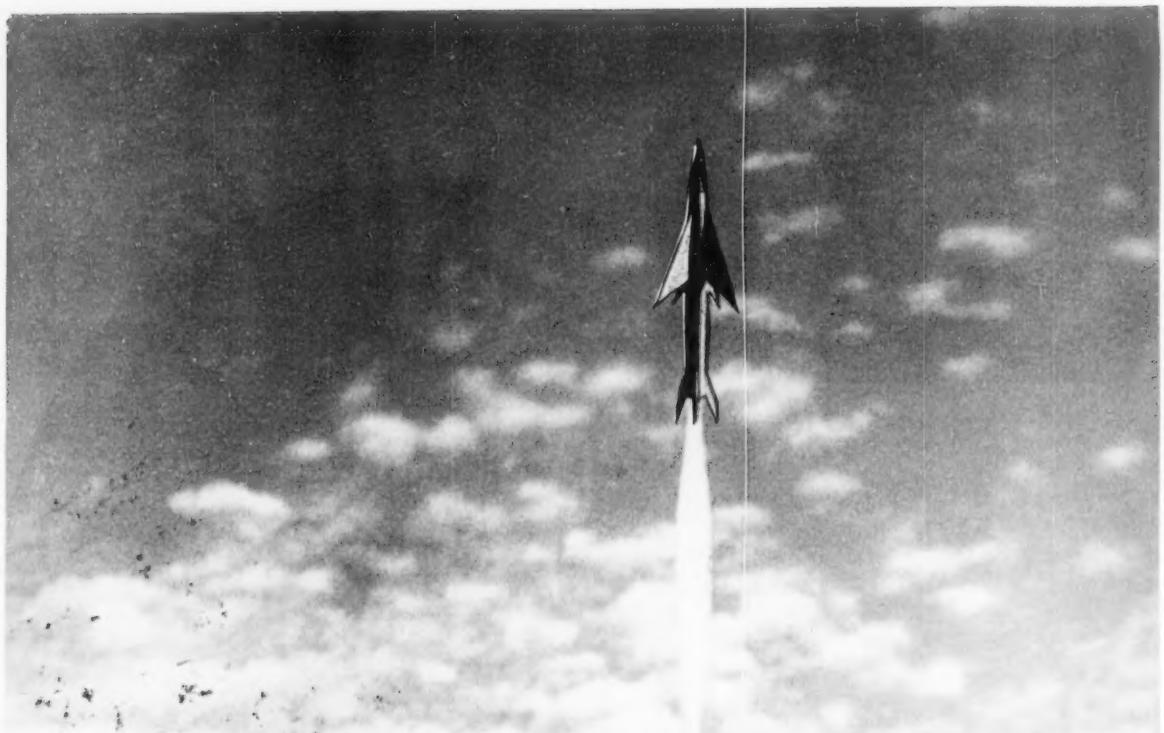
In Canada: McKinnon Industries, Ltd., St. Catharines, Ontario



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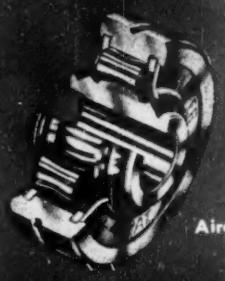

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Aircraft Bearing

LEADING BEARING DESIGN
FOR MORE THAN 35 YEARS

SHAFER BEARING
DIVISION OF CHAIN BELT COMPANY

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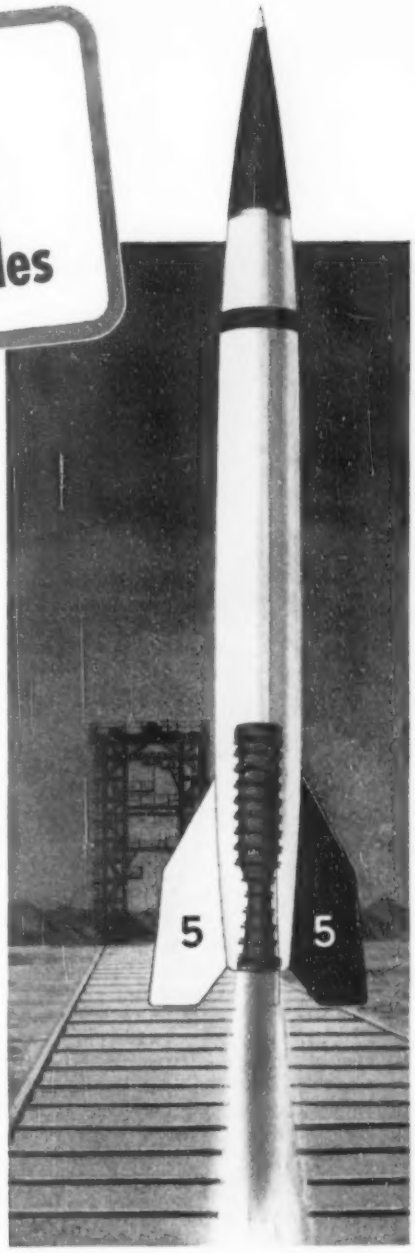
# RYAN builds ROCKET MOTORS for 3000 mile-per-hour missiles



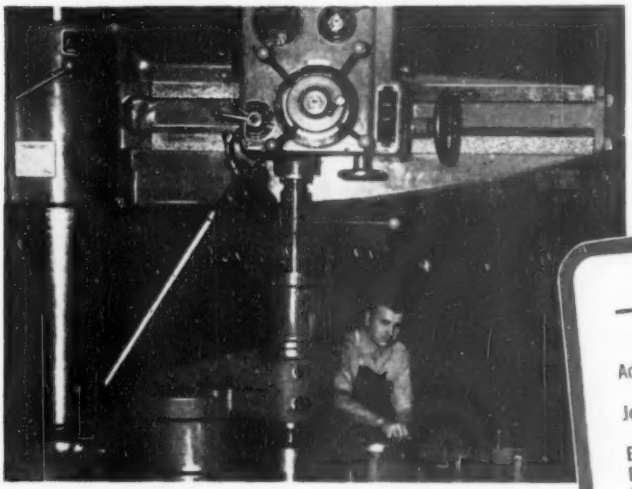

IMAGINE a motor powerful enough to propel a missile at speeds exceeding 3000 mph . . . so powerful that its developed thrust can amount to tens of thousands of pounds. One of Ryan's most challenging current assignments is the complete production of such a motor for an Army Ordnance surface-to-surface missile.

There was a many-sided problem of fabrication, welding and machining that Ryan had to solve in connection with rocket motor manufacture. Because a rocket motor is capable of burning as much as a ton of fuel a minute at temperatures up to 5000 degrees F., terrific internal pressures are created that must be contained in a very compact package of complex construction and exacting dimensions.

The solution was found in perfecting new techniques for forming, welding and machining the special alloy materials. Ryan devised new methods of controlling work to very close tolerances; ingenious electric resistance and arc welding processes and a better furnace brazing system . . . plus intricate machine operations that had to be jewel-like in precision.

Ryan's proved ability in the production of complete rocket motors is due in large measure to its long experience in building the "hot end" of jet and piston engines. Its versatility in many specialized fields is an important advantage in each new assignment, for it enables every division to draw on 31 years of first hand experience in the most advanced phases of aviation engineering and production.

Thus, each year more unique technical engineering and production projects are awarded Ryan . . . an integrated company with superior abilities in meeting the challenges of today's high-speed air age.



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The tireless research of many minds, the skilled precision of many hands, the endless hours of testing and developing of the Pioneer Parachute Company are all dedicated to a single aim . . . to create parachutes that deliver the goods *where* and *when* they're needed most . . . without accident, without damage.

Behind mass cargo drops, where guns, jeeps, supplies and food are parachuted down with pinpoint accuracy, are years of experiment, toil, and experience that give Pioneer its rare blend of creative engineering ability and production "know-how".

From Pioneer's vast manufacturing plant to the distant fronts go the parachutes whose ultimate mission is to carry new strength and new hope to earth-bound fighting men below.

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CABLE ADDRESS: PIPAR, Manchester, Conn. U.S.A.

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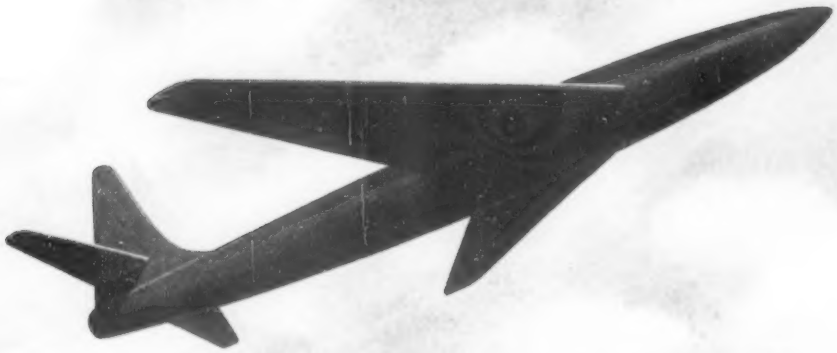
# Your future's on the rise when you're an aviation electronics engineer with RCA!



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**PRECISION NAVIGATION**

**COMMUNICATIONS**

**POSITIONS IN:** ***SYSTEMS, ANALYSIS, DEVELOPMENT or DESIGN ENGINEERING***

***Specialize in:*** Radar . . . Analog Computers . . . Digital Computers . . . Servo Mechanisms . . . Shock & Vibration . . . Circuitry . . . Heat Transfer . . . Remote Controls . . . Sub-Miniaturization . . . Automatic Flight . . . Transistorization . . . Design for Automation.

You should have 4 or more years' professional experience and a degree in electrical or mechanical engineering, or physics.

In these positions at RCA, there's a real engineering challenge. You'll enjoy professional status . . . recognition for accomplishment . . . unexcelled facilities . . . engineering *graduate* study with company-paid tuition . . . plus *many* company-paid benefits. Pleasant suburban and country living. Relocation assistance available.

*Look into the RCA career that's waiting for you! Send a complete resume of education and experience to:*

**Mr. John R. Weld, Employment Manager**
**Dept. B-450H, Radio Corporation of America**
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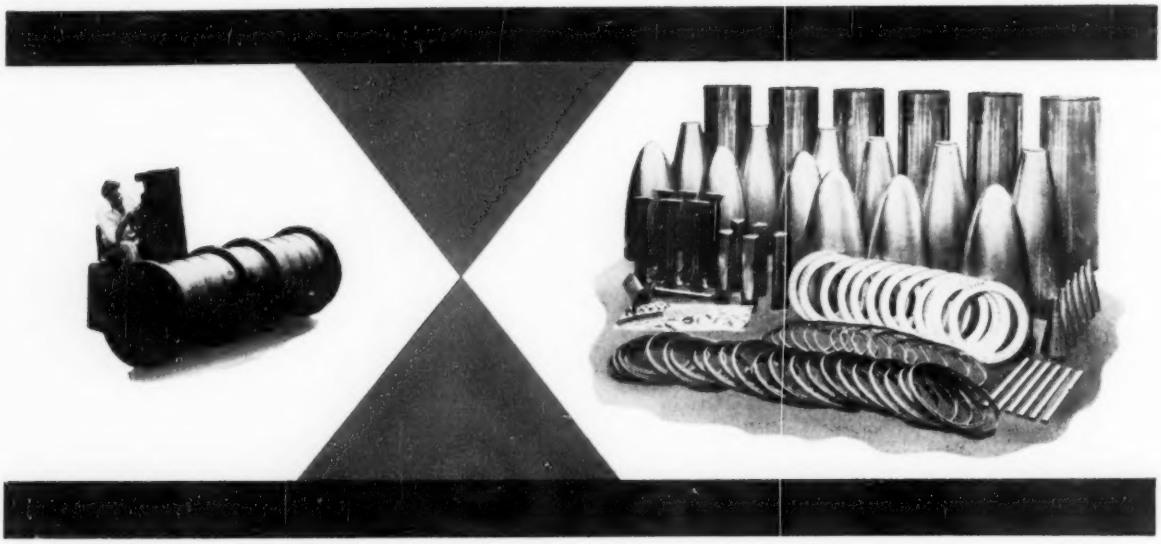
**RADIO CORPORATION OF AMERICA**

# NOW...WING TANKS COME IN CANS



*Royal Jet needs qualified aeronautical engineers. Write stating qualifications.*

*first in the design, development, and manufacture of high-nesting jettisonable fuel tanks.*

*Latest development in jet wing tank production is an unusual new Tank Can designed and manufactured by Royal Jet, Inc. for Type II (high-nesting) jettisonable fuel tanks. This new Tank Can replaces wood crates.*

**ADVANTAGES:**

*Royal's Tank Can saves 40% in storage and shipping space, 25% in weight, and 10% in cost against old wood crates. Wing tanks are hermetically sealed in steel — indefinitely preserved.*

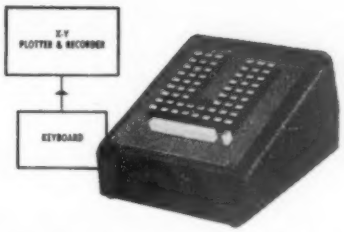
**PROOF:**

*Spacewise — in the same freight car that once held only 140 high-nesting jet wing tanks, Royal now loads 262 (enough wing tanks for an entire jet fighter group). If these wing tanks were shipped assembled, Royal could pack only 18 to a car.*

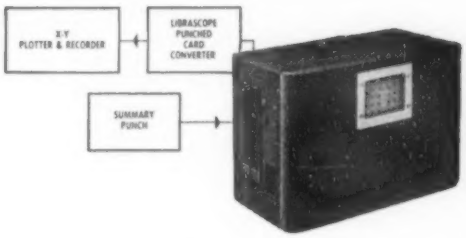
*This economical new Royal Jet container is now standard for the United States Air Force.*

**ROYAL JET INC.**

*Alhambra, Calif.*
*(formerly Royal Heaters, Inc.)*



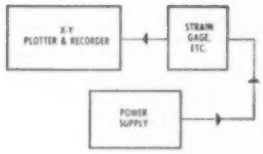

**DECIMAL KEYBOARD:** Consists of a three-decimal bank for each axis with associated plus-minus keys. Depressing plot bar initiates plot and clears keyboard automatically. Also manual clear button. Size: 8½ x 11 in., Weight: 12 Lbs.




**PUNCHED CARD CONVERTER:** Converts punched card data to an analog form suitable for input to X-Y Plotter from Gang Summary or Reproducing punches. Display Monitor. Total tube complement 26 tubes.

# X-Y plotter and recorder

## simplified recording of two independent variables with greater selection of input devices




**D.C. INPUTS:** 5 millivolt full scale sensitivity on both axes. Infinite input impedance for signals to .5 volts. 2 megohms input impedance above .5 volts.

A compact, desk-size unit that accepts either analog or digital inputs. Standard digital converters: Decimal keyboard, Decimal punched card, and Binary for Computer Outputs. Handles remote mechanical shaft rotations directly without modification. Modifications available to customer specifications. Full chart visibility allows observer to view curve generation at all times. Unique pen travel for fast, dependable performance. Write for full catalog information.

**DESCRIPTION:**
Desk or Rack Mounted
(RCA or RMA)
Accuracy: .1%
Weight: 70 lbs.
Uses Standard Graph Papers:
11"x16½", or 8½"x11"
Power Consumption:
150 watts, 115 volts, 60 cycles

**Engineers, physicists and mathematicians in search of interesting assignments, rapid advancement, and job security are requested to write Dick Hastings, Personnel Director.**

Computers & Controls

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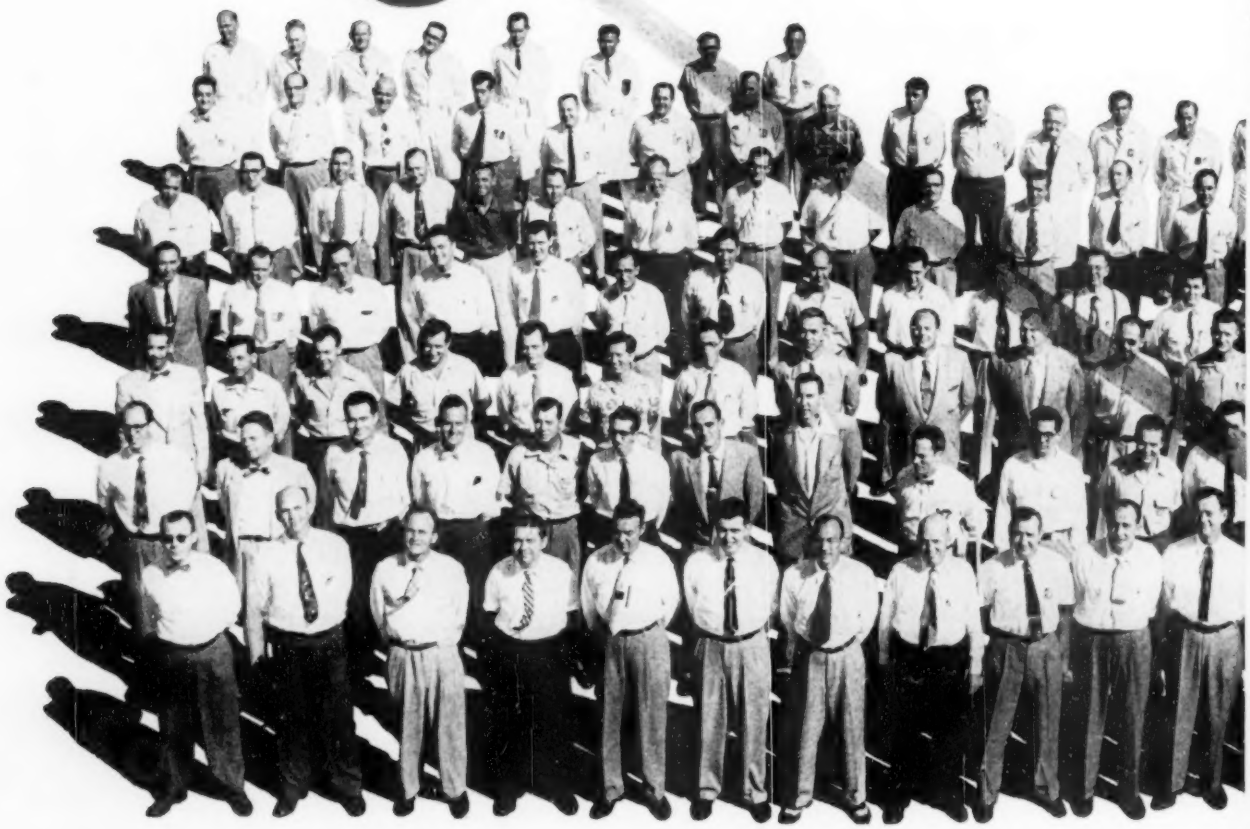
# 5 CENTURIES OF MISSILE at Bendix-



These are our key people . . . an integrated team of engineers, production supervisors and field representatives who have made significant contributions to Uncle Sam's growing missile might.

Since 1946 when Bendix-Pacific began its activity in the guided missile equipment field, more than 500 man-years of experience has been accumulated by these people. They will produce many of the hydraulic and electronic systems for tomorrow's Air Force, Army and Navy missiles, with competence born of that experience. Backing up these key people are more than 2,000 skilled workers, experienced in meeting today's exacting missile requirements.

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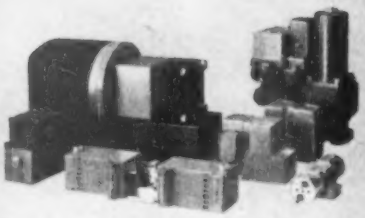
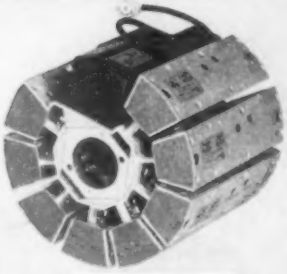
# EQUIPMENT EXPERIENCE

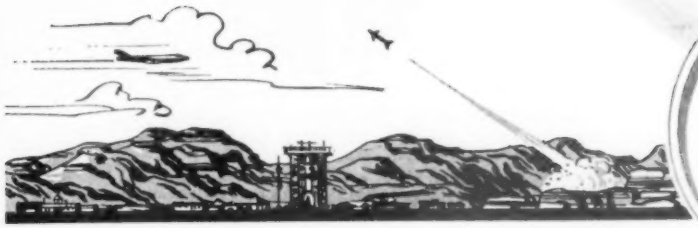
## -Pacific



HYDRAULICS



ELECTRONICS



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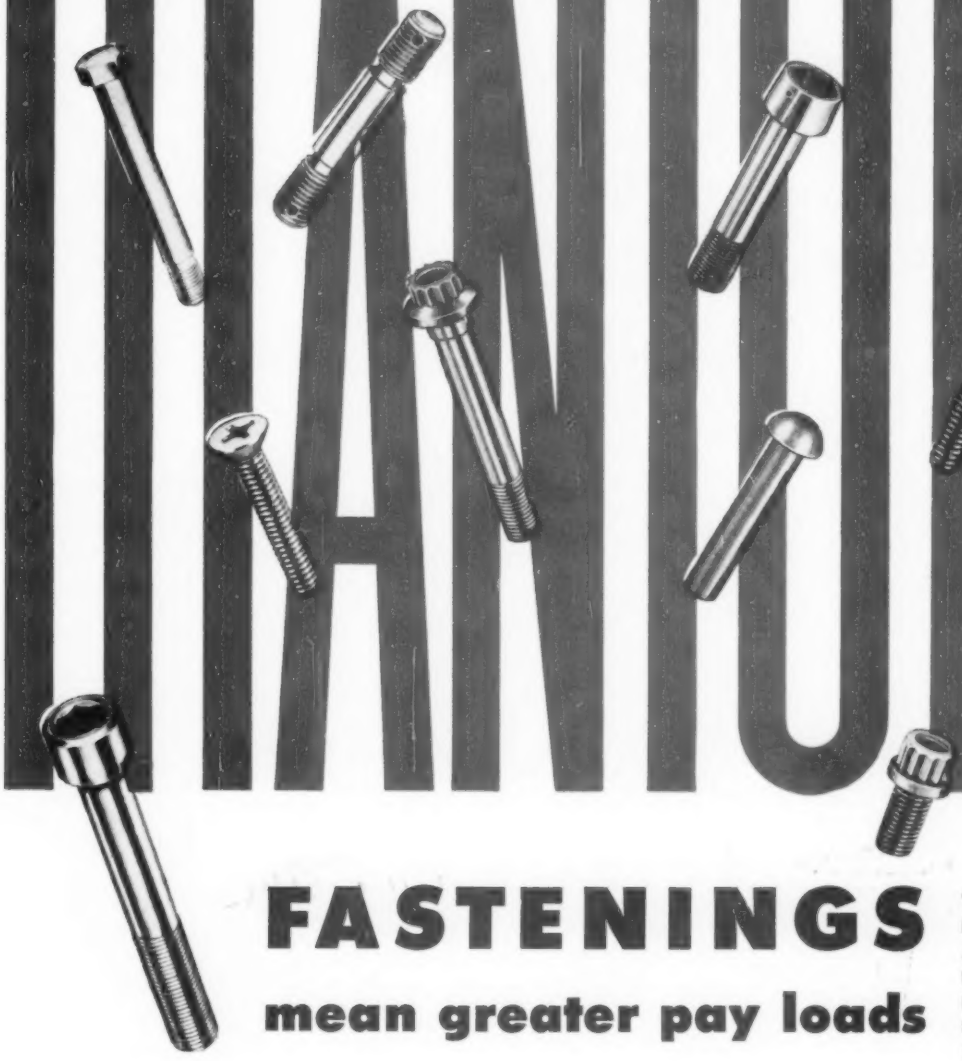
# TITANIUM



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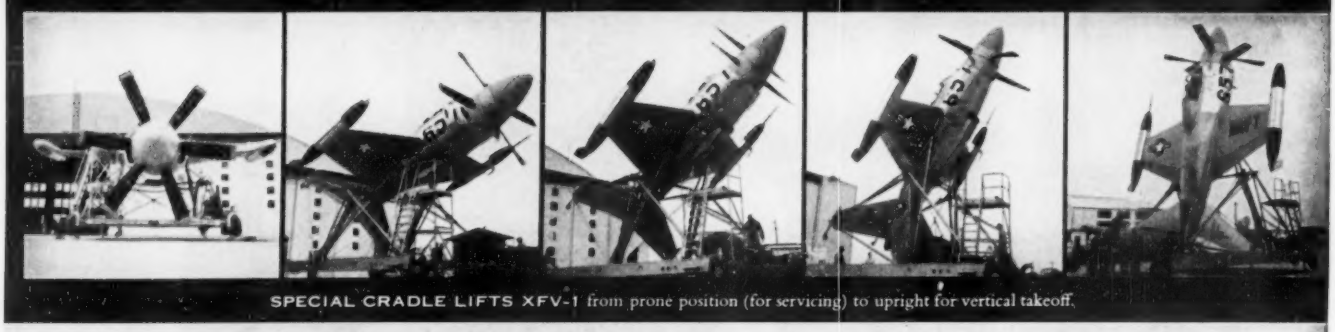
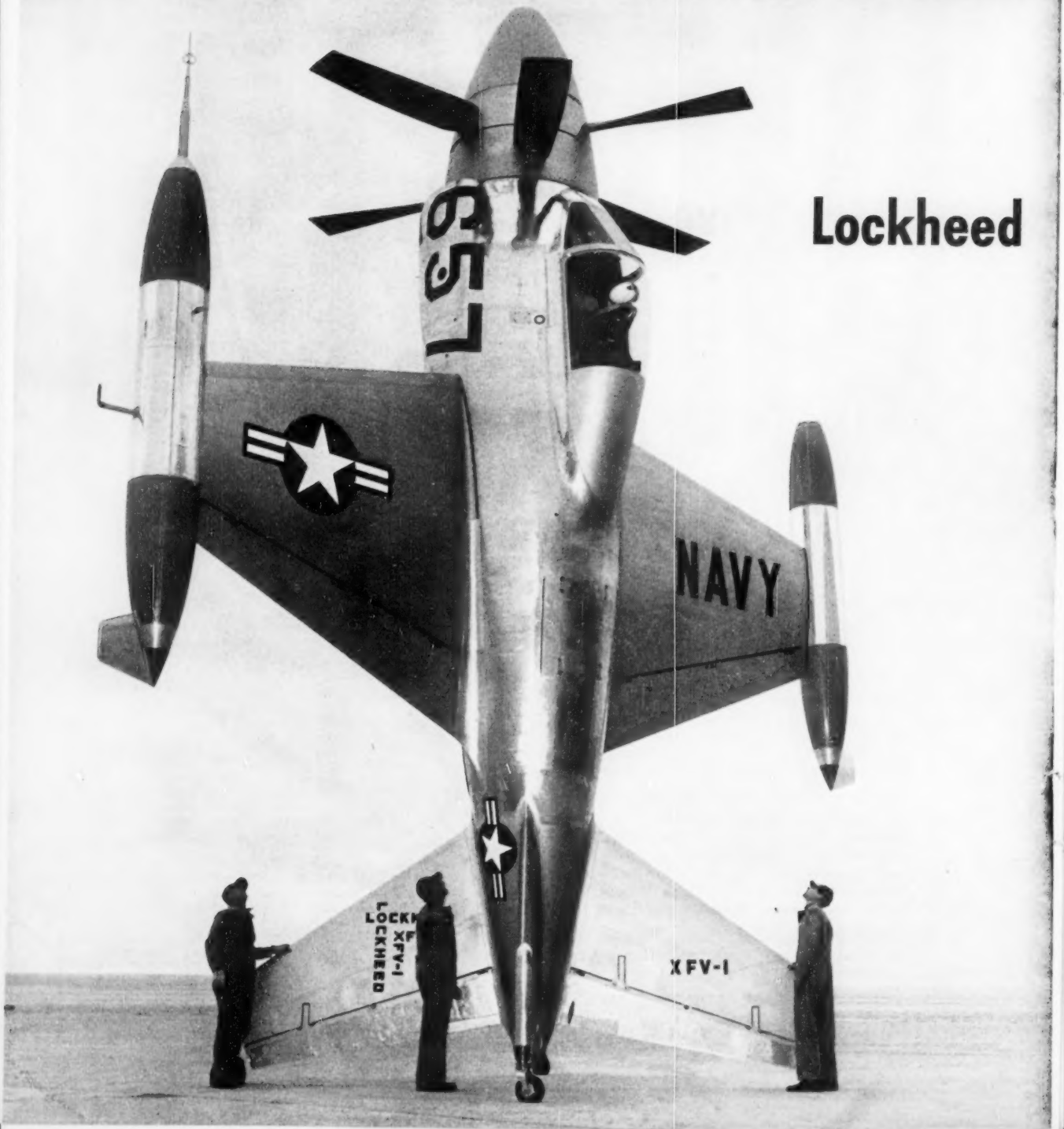
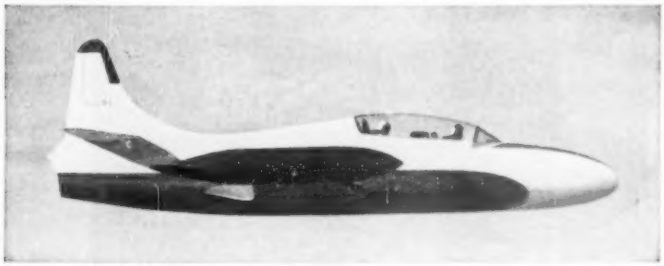


SPECIAL CRADLE LIFTS XFV-1 from prone position (for servicing) to upright for vertical takeoff.

# Lockheed



*LEADERSHIP DEMANDS CONSTANT ACHIEVEMENT*



**WORLD'S SAFEST JET AIRPLANE.** Greater power, larger cockpit, but, above all, more safety have been engineered by Lockheed into its new jet trainer. New stall slats, drag chute, Zero Reader and pilot "stick shaker" device to automatically warn about possible stall are just a few of added safety features. Trainer combines jet combat performance with maximum operational safety. Easier to fly than simple propeller-driven trainers.

**GUIDED MISSILE** and pilotless aircraft research is advancing rapidly at Lockheed. Here engineer-scientists from the Missile Systems Division test top-secret developments to meet problem of supersonic speeds yet unattained.

# Scientists Unveil Radical Forms of Flight

## *High-Speed Navy Fighter Takes Off Straight Up, Lands by Backing Straight Down on Its Tail*

Today's biggest news in aviation is the Navy's XFV-1 built by Lockheed, a revolutionary new vertical-rising plane.

A powerful Allison turbo-prop engine with two jet turbines turning counter-rotating propellers lifts XFV-1 straight up, rocket fashion. It levels off for speeds in the 500-m.p.h. class, lands on its tail.

Many Lockheed "firsts" are built into this airplane. A ¼-scale model powered by a 76-h.p. electric motor was built and flown to test vertical ascent, transition into level flight, and landing. Careful weight control permitted completion of first prototype hundreds of pounds less than estimated weight for Navy requirements.

Unique 4-way tail serves as a single surface and jointly functions as elevator, aileron and rudder, using revolutionary interlocking controls.

**SOUND ENGINEERING** pays off with Lockheed P2V Navy patrol bomber. The famous Neptune has increased gross takeoff weight and boosted speed by adding powerful jet pods. Neptune's aerodynamic configuration, however, remains unchanged from original X model 11 years ago through the current 7 series.

**FIRST ROUND-THE-CLOCK** flying radar station in the world is this Lockheed Early Warning Aircraft (designated WV-2 by Navy and RC-121C by Air Force). Huge 600-gallon tip-tanks extend radar-laden Super Constellation's range. Plane carries more scientific equipment than any other known aircraft—some six tons of electronics. Bottom radome, the size of a swimming pool, is largest plastic part ever built. Although it is held to plane by only 10 bolts (no metal ribs), radome is built to withstand aerodynamic pull of up to 60,000 pounds. Super Constellation's three-tail design insures aircraft controllability despite air-flow disturbance created by protruding radomes.

# Lockheed

*California Division—Burbank, California*
*Georgia Division—Marietta, Georgia*
*Missile Systems Division—Van Nuys, California*
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*Lockheed Air Terminal—Burbank, California*

*LOOK TO LOCKHEED*
*FOR LEADERSHIP*

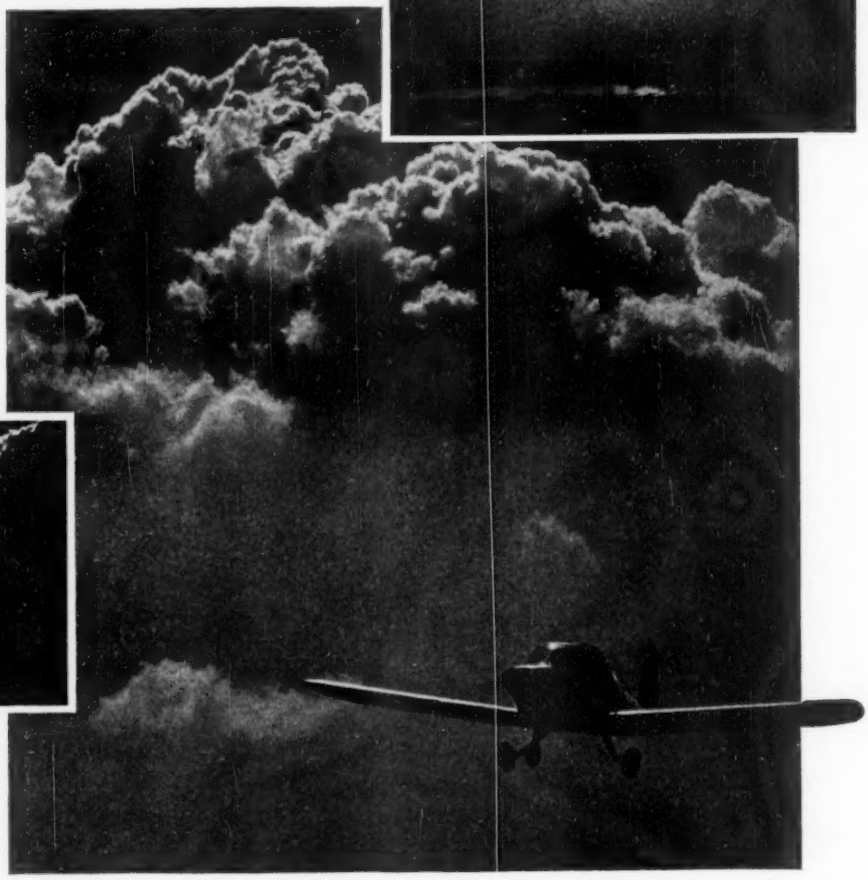
**NEW FLIGHT FORMS** are studied by Lockheed scientists to meet sonic and thermal problems of ultra-high speed, higher altitudes. Nearly a decade of research on wing shapes alone results in new Lockheed forms in Mach 2 to Mach 3 range. Lockheed has tested almost 100 distinctly different wing models on supersonic rockets.

# FLY WEATHER-WISE

*[These weather items prepared in consultation with the United States Weather Bureau]*

**To lessen chances** of lightning strike, slow down your air speed, stay out of clouds, especially when gauge indicates near freezing temperatures or precipitation.

**Scattered** fast-moving low clouds on a calm, clear morning indicate strong surface winds will soon develop because sun's heat stirs the winds from aloft to the ground.



**Clearing,** with a wind shift to west after a thunderstorm, does not always signify passage of a Front—but possibly a pre-frontal squall line. Another band of showers and cloud may follow in an hour or two with the real frontal wind shift.

**Clouds made up** of dry-snow crystals appear fuzzy around the edge. Water clouds have a hard, sharp outline. It is the latter type which presents the greater icing hazard.

# Best Pair to Get You There

A QUICK LOOK at the sky and a weather-wise pilot can often foretell flying conditions. Just as one glance at the Flying Red Horse emblem signifies—here's the place to get the best aviation fuels and lubricants.

Mobilgas Aircraft and Mobiloil Aero mean smooth power and performance from take-off to landing. They're products of the world's greatest lubrication experience... approved by every major aircraft builder. Fly Safely...fly with the Flying Red Horse.

Mobiloil AERO

Mobilgas AIRCRAFT

SOCONY-VACUUM OIL CO., INC. and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

# HERE'S A REAL HOT "FLASH"

Slashing over enemy territory and thundering its way back with vitally needed intelligence data . . . Republic's **RF-84F THUNDERFLASH** is the latest addition to the long line of Thunder-craft. ➢ ➢ Fully equipped for any battle-front photo reconnaissance mission the RF-84F is capable of operations the clock around. More powerful than any of its battle-tested predecessors, the swept wing **THUNDERFLASH** is particularly well fitted . . . with protective armament, its tremendous speed and high maneuverability . . . to fight its way out of trouble, if and when necessary. ➢ ➢ Sturdy counterpart of the highly effective **THUNDERSTREAK,** this new plane. is being delivered in quantity to the U. S. Air Force. For more than a decade and a half Republic-designed aircraft have faithfully served our armed forces in the fight against tyranny.

**REPUBLIC AVIATION**

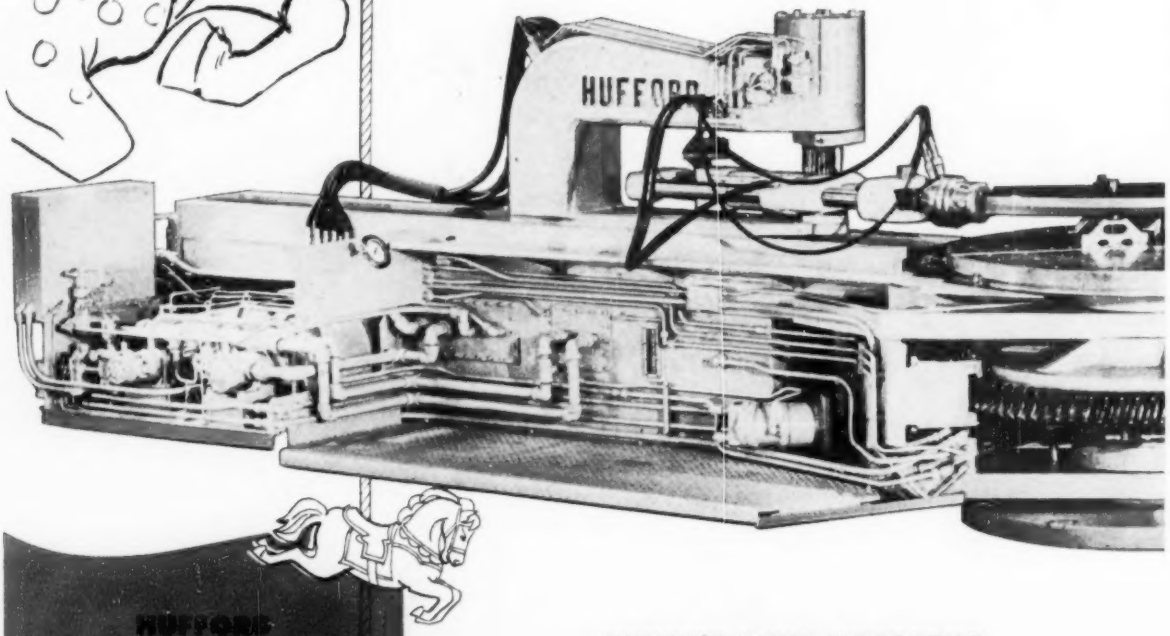
FARMINGDALE LONG ISLAND, N. Y.

*Designers and Builders of the Incomparable* **THUNDER-CRAFT**

## Now, RIDE the Hufford

# CAROUSEL

## to new possibilities on TOUGH FORMING JOBS!




**HUFFORD**

**CAROUSEL**

Now combines all these functions in one machine!

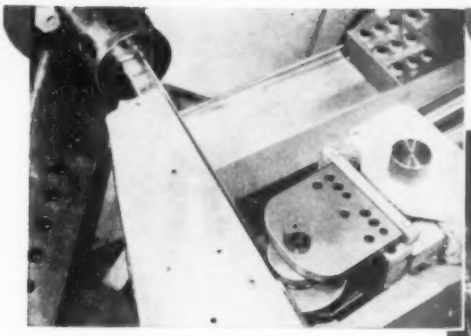
- STRETCH-WRAP FORMS UP TO 360°
- ROLL FORMS
- WIPE FORMS
- JOGGLES
- BULLDOZES
- REVERSE BENDS
- STRETCH LEVELS

### TODAY'S MOST VERSATILE FORMING MACHINE!

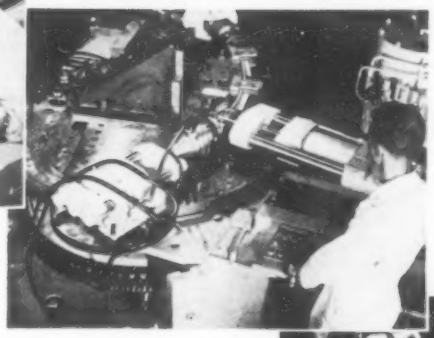
Hufford CAROUSEL is a totally *new* stretch-wrap forming machine! It greatly extends the range of forming—in contours produced and forming methods employed. The CAROUSEL actually combines several forming methods in one machine! As a result, *you can now make parts in one setup without additional accessories...you can eliminate as many as 4 to 5 operations, cut hand forming and reduce overall forming time and cost!*

BUSIEST MACHINE IN THE PLANT! Forms all materials—sheets up to 22" wide as well as extrusions, etc. Keeps busy because of its extreme versatility!

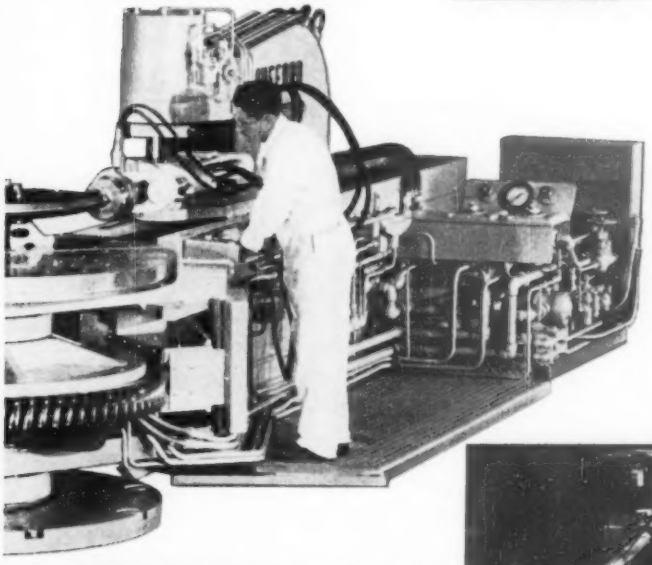
*Before investing in any forming machine get the facts on the new Hufford CAROUSEL the one machine that does the work of many!*

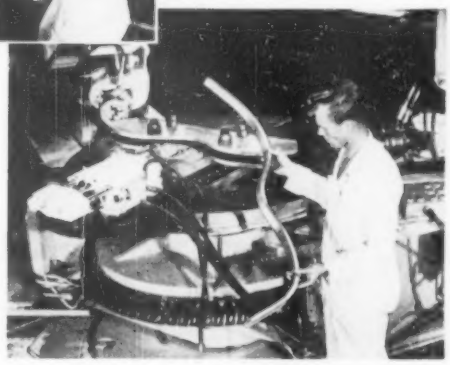


ROLL FORMS AND WIPE FORMS with either arm simply by replacing jaw with correct tooling. Arms are reversible at any stage of forming, permitting any number of passes over work.

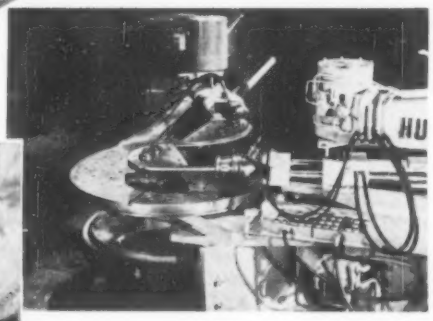


JOGGLES without accessory equipment. Either rolls part into joggles or bulldozes with joggle blocks.





BULLDOZES—Makes complicated contours without time loss for adding and removing insert blocks.



FORMS "S" CURVES IN ONE SETUP—Arms wrap simultaneously in counter-clockwise direction to form this "S" curve.

DUAL CONTROLS—Control panels are portable—may be used on one arm with a single operator or on each individual arm with two operators.

FORMS FULL CIRCLES IN ONE PASS—360° arm rotation forms full circles. Arms rotate independently or simultaneously under variable speeds.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# Pacitron*

*measures and manages fuel for guided missiles*

Now an important new achievement—the design and installation of a fuel gage system for an advanced type of guided missile—has been added by Simmonds Aerocessories, Inc. to its long record of leadership in the development of aircraft capacitance fuel gage systems.

In this installation, the Pacitron system makes provision for telemetering vital information to control points, in addition to the accurate and reliable measurement of fuel available.

Under the stress and pressure of sub-sonic and super-sonic speeds, Pacitron once again successfully demonstrates the high performance features that have made Simmonds first in electronic fuel gaging.

*Pacitron is a U. S. trademark

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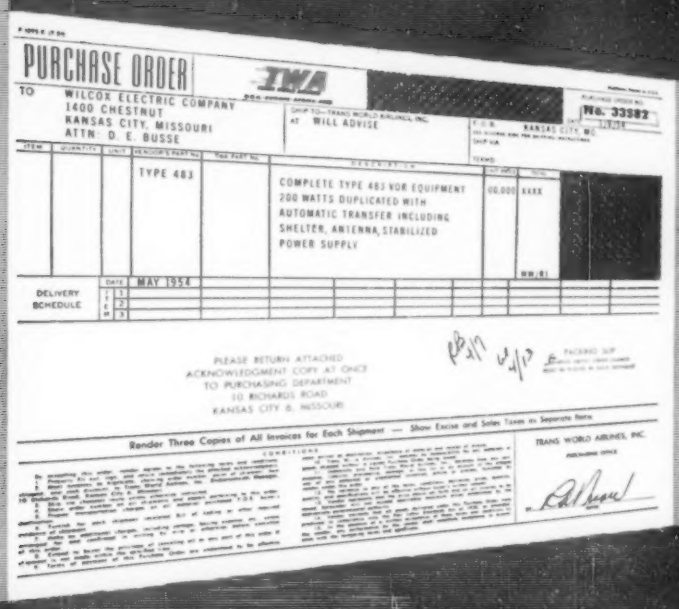
The Extra Engineer—When Pacitron fuel gage system provides fuel management as well as fuel measurement.

**Pacitron Measures Hard-to-Measure Liquids**

The uniquely designed sensing element (tank unit) of the Pacitron system is particularly adaptable to the measurement of hard-to-measure liquids. In addition to aviation gas, kerosene and the JP fuels, Pacitron has successfully gaged engine oil, water methanol, nitric acid and other conductive fluids. Compensation for deviation in types of fuels also can be provided through a monitoring device.



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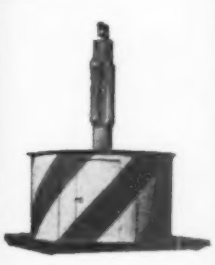
TWA bought *dependability* when they ordered Wilcox VOR equipment. Dependability that insures accurate navigation.

So can you! Why don't you investigate? Write today for complete information and specifications on how Wilcox 483 VOR equipment can provide you with freedom from interference . . . greater safety of operation under all weather conditions, here or abroad.



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## *Who pays half fare when they go by air ?*

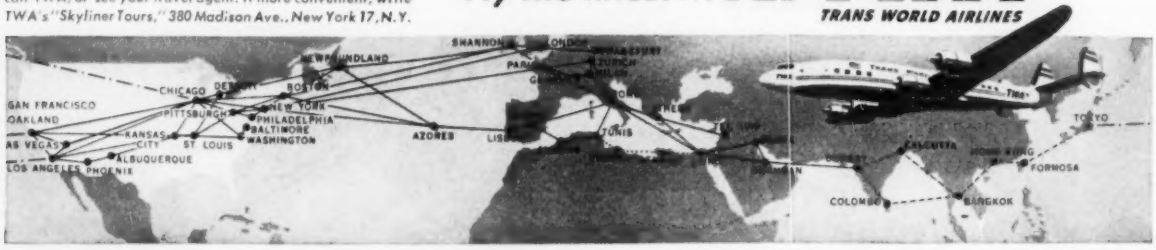
Everyone except Dad! Yes, Mom and all the children* travel at half fare and love it. Yes, Mondays, Tuesdays and Wednesdays are Family Half-Fare days on TWA flights in the U.S.A. – days when speed is just as swift and First-Class Constellation luxury is every bit as delightful. It's the thrifty way to vacation fun – the perfect way to take the whole family along when you're called out of town on business. Next trip, let TWA show you how little it takes to make travel by air a family affair.

*Under 22 years of age! One baby under 2 goes free.

***Mountains or seashore**—there's time enough to see both and satisfy every member of the family when you plan your vacation with a swift TWA Constellation.*

*Where in the world do you want to go? For reservations, call TWA, or see your travel agent. If more convenient, write TWA's "Skyliner Tours," 380 Madison Ave., New York 17, N.Y.*

***Fly the finest...* FLY TWA**
**TRANS WORLD AIRLINES**



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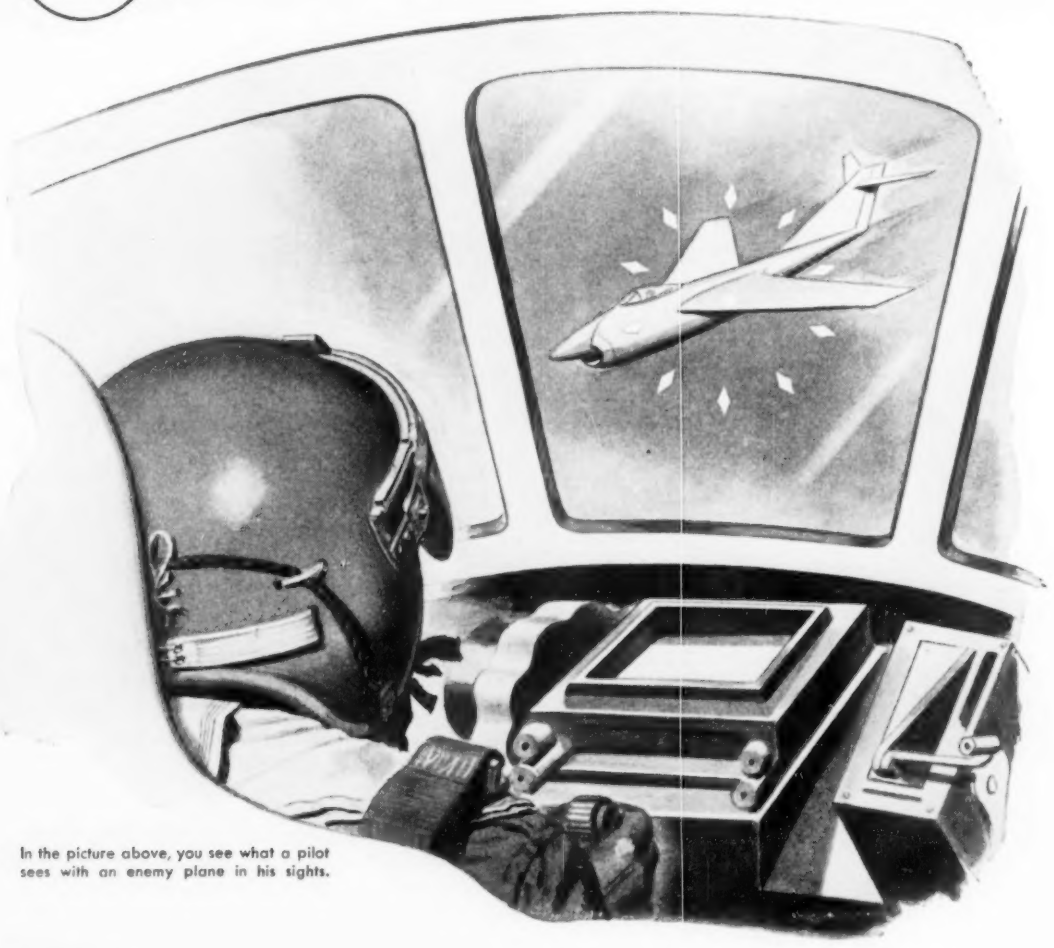
STRESSED PANEL FASTENER
a complete departure from conventional fastening

# Bull's-eye in the stratosphere...



In the picture above, you see what a pilot sees with an enemy plane in his sights.

AC QUALITY PRODUCTS

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AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION
FLINT, MICHIGAN

Today's pilot centers the ring of light on his windshield on target. He trips the trigger... bull's-eye! It's an automatic "kill."

That can, of course, be a tough job, but it *looks* simple and it *is* remarkably simple by comparison with earlier sighting methods. And behind that apparent simplicity lies one of the most complex electro-mechanical devices ever produced. It's the A-4 Gun-Bomb-Rocket Sight, produced in quantity for our fighting planes by AC.

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BECAUSE planes fly literally to the four corners of the earth, service facilities of the Scintilla Division of Bendix are found in strategic air centers around the world. We are firm in our belief that competent service, readily available, is vital to complete customer satisfaction.

This world-wide service organization is well trained and in turn is backed up by Scintilla Division's own field service staff who have at their command the complete service facilities of an organization that has specialized in ignition equipment for over thirty years.

Thus, whatever you buy—or wherever you fly—you know that the name Bendix® on any ignition product means "The Most Trusted Name in Ignition."

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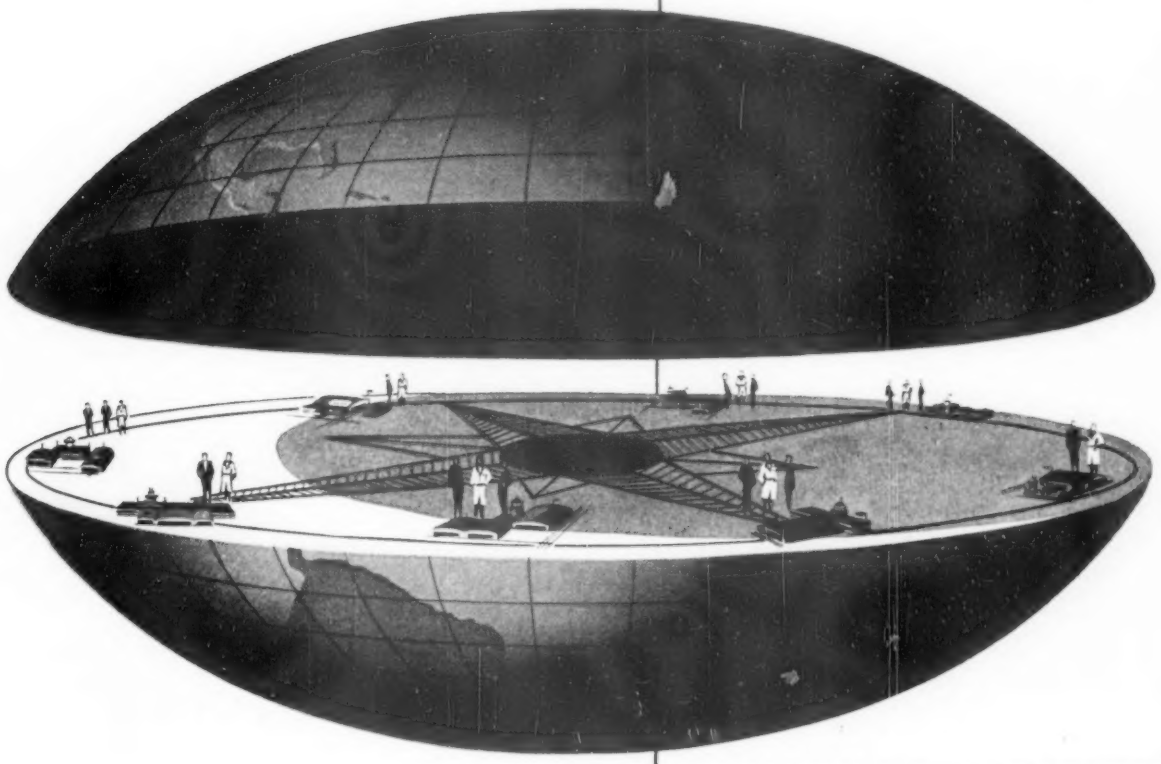

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# New AMERICAN Inertia Reel

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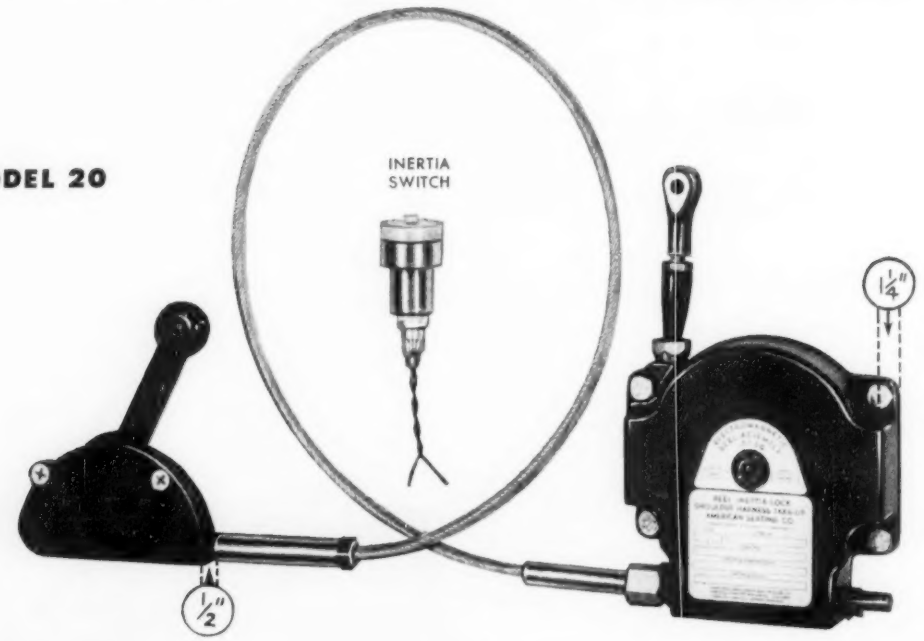


## MULTIDIRECTIONAL SHOULDER HARNESS TAKE-UP

1. **Lightest Reel**—about 1.5 lbs.
2. **Thinnest**—1¼" over-all, at least 5/16" thinner than any other reel.
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4. **Lowest in cost** of any multi-directional reel.
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6. **Full 18" harness cable travel,** as called for in Specification.
7. **Ideal for ejection seats.** Locks instantly and automatically when electrical circuit is interrupted during ejection cycle. This eliminates weighty linkage, always needed in reels with straight mechanical control.
8. **Manual control is thinnest ever made,** only ½" thick over-all. It is fast and positive in locking and unlocking action.
9. **Reel cannot be unlocked by quick retracting movement,** once it has been locked by inertia.
10. **Can be mounted in almost any position,** as inertia locking action is controlled by a new inertia switch, mounted independently of reel. This switch can be mounted anywhere in the aircraft, and will operate reels on several seats, or other equipment. Switch weighs only about 1½ ounces.
11. **Reel can be disassembled** and overhauled by user without returning to factory for recalibration. Only the simple, trouble-free inertia switch is factory-sealed.
12. **Design incorporates suggestions** of aircraft manufacturers, and is manufactured by experienced aircraft technicians. Experienced aircraft engineering personnel available for consultation.
13. Uses same mounting hole spaces as other reels of our manufacture.
14. Mock-up units available for your development work.

*American Seating Company is the original producer of the Inertia Locking Shoulder Harness Safety Reel, and has supplied the Armed Forces since 1942. We also manufacture Unidirectional Reels conforming to Type MA-1 of Specification MIL-R-8236 and Specification AN-R-29, Amendment 2.*

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## TO INSTRUMENT MECHANISM DESIGN . . .

In any aircraft instrument system, reliable performance depends on an indicating mechanism which presents the information accurately, rapidly, simply and intelligently to the pilot. To Marion, who makes both moving coil mechanisms as components of indicating systems and complete integrated systems, this means specifically designing mechanisms to accomplish system objectives in an environment of vibration, rapid attitude changes and other influences, with full realization of the human elements involved.

This approach is represented by Marion's MEP-1 and Coaxial Mechanisms, which were designed to meet specific performance requirements in an indicating assembly for radio navigational use. The MEP-1 exhibits exceptional, gyro-like stability even under the influence of severe vibration and rapid attitude changes. The Marion Coaxial Mechanism is an extremely small, lightweight and rugged movement; its performance and durability exceed that of much larger and heavier moving coil mechanisms.

COAXIAL

MEP-1

These are typical Mechanisms by Marion — examples of advancement in instrument design to better meet the critical needs of specific applications. Marion invites your inquiry concerning the application of Marion Mechanisms to your problems.

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*advancement in instrument design*

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# marion meters

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On this Lockheed All-Weather Interceptor, Lockfoam is used to provide structural strength, lightweight construction, and improved performance. Lockfoam is used in both their commercial and military planes by Lockheed Aircraft Corporation.

# NOPCO LOCKFOAM

## Versatile *NEW* Structural Tool

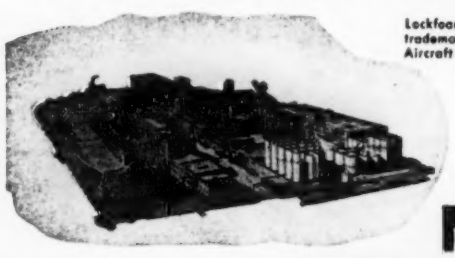
NOPCO® Lockfoam offers many new concepts in aircraft design, engineering, and manufacture.

As a strong, lightweight reinforcing material it has won immediate acclaim in the aircraft industry.

In addition to its unique ability to be foamed in place with exceptional ease and speed without the need for complicated equipment, Nopco Lockfoam possesses so many other interesting properties that it has proved ideal for countless applications.

Nopco Lockfoam can be foamed in place to fill any cavity regardless of configuration. Density of the material can be adjusted to meet design requirements. Bonding is automatic. Radar transmission characteristics are excellent. It can be used for electrical and thermal insulation. In its flexible forms, it is capable of absorbing heavy impact loads with low shock transmission. Physical and chemical properties may be varied but are predictable and reproducible. Lockfoam can also be cast in molds, fabricated in both rigid and flexible forms.

The assistance of a technical service staff in the selection, formulation, and application of Lockfoam is available from Nopco's Lockfoam Division. Send for complete technical data.



Lockfoam is a registered trademark of Lockheed Aircraft Corporation



Nopco Lockfoam provides rigidity and strength for plane ailerons. Note cellular structure of rigid Lockfoam thermosetting foamed-in-place plastic.

Nopco Lockfoam is now used by the aircraft industry for a wide variety of applications to:

**INCREASE RIGIDITY OF CONTROL SURFACES** by filling cavities in ailerons, rudders, elevators, wing tabs

**PROVIDE A STRONG CORE** sandwiched between Fiberglas skins for nose radomes

**STRENGTHEN SHOCK-ABSORBING STRUCTURES**

**INSULATE** cabin ventilating systems

**STIFFEN** rocket doors to prevent buckling

**FABRICATE SHOCK PANELING**

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Nopco Lockfoam has many other potential industrial uses. Call or write Nopco for details and technical service.

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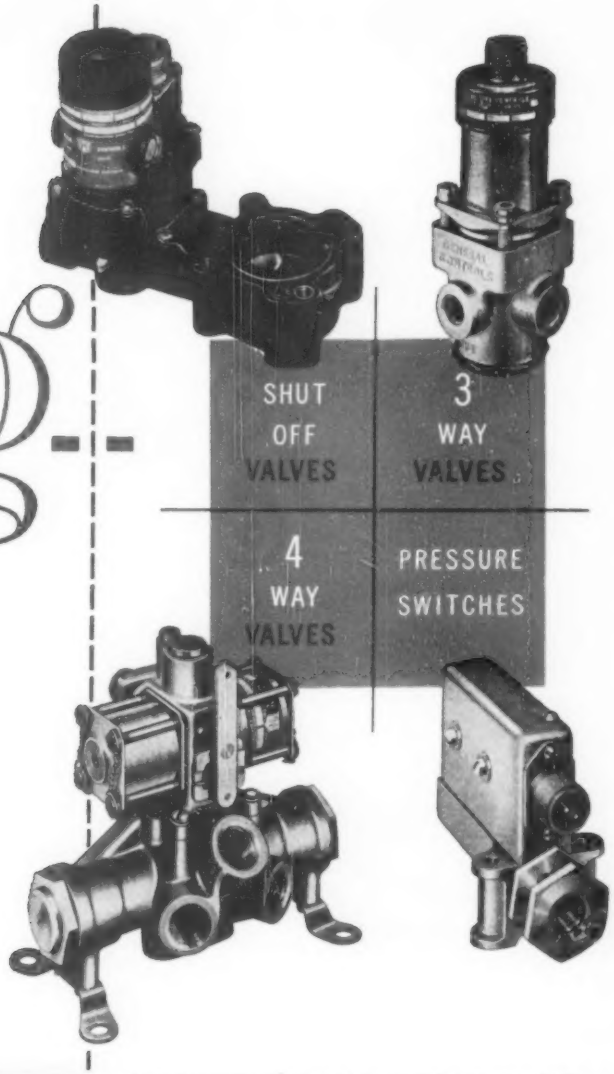
# hi-g

## for aircraft




General Controls

hi-g controls

In engineering terms "high g" means high gravitation forces. In performance terms "Hi-g" means General Controls' reliable line of automatic pressure, temperature, level and flow controls for heavy duty under acceleration factors from 10 to 300G. The Hi-g line comprises electromagnetic pilot and shutoff valves . . . manual and motor-driven gate valves . . . electrohydraulic selector valves . . . gauge and differential type limit controls . . . all light in weight, compact in design and trustworthy in operation . . . handling a great variety of liquids and gases in a wide temperature range.

For high efficiency performance under extreme vibration and acceleration conditions it's General Controls Hi-g Controls . . . the best in automatic control for any machine that rolls, floats or flies.

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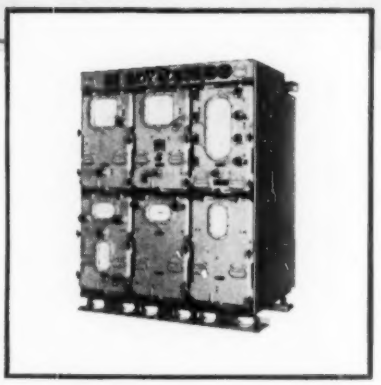
An enemy guided missile comes winging towards our task force . . . at speeds of up to 20 miles a minute. What kind of computer can predict and compute the necessary data fast enough to shoot down the missile . . . and be reliable every time? That was the problem posed to Ford Instrument Company engineers . . . and in cooperation with the Navy, they found the answer. Compact equipment, housed in easy-to-service units . . . that stand at the front line of our defense.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.



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**You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.**

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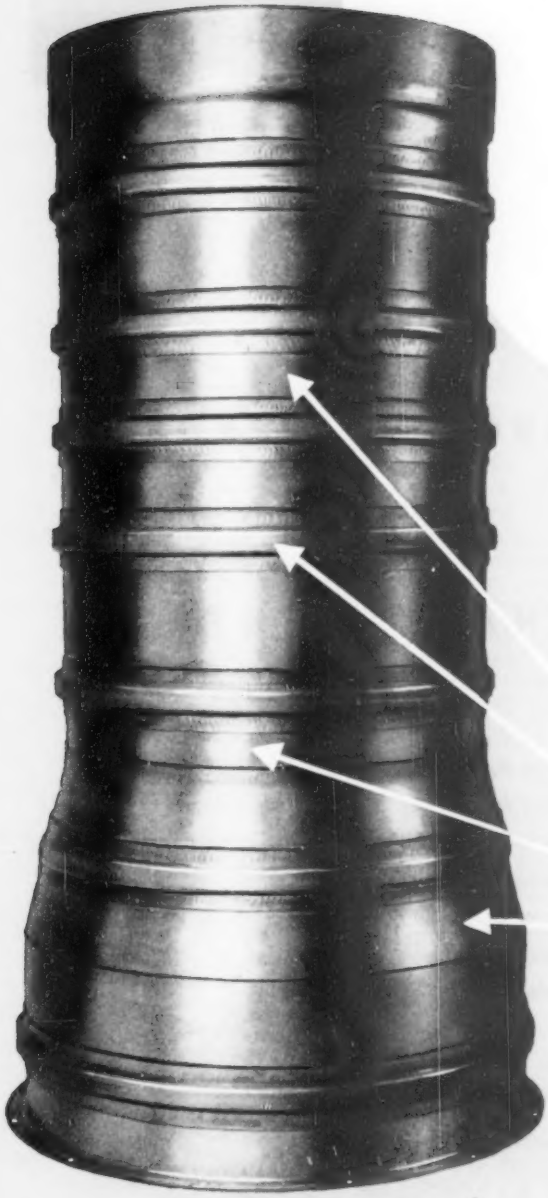

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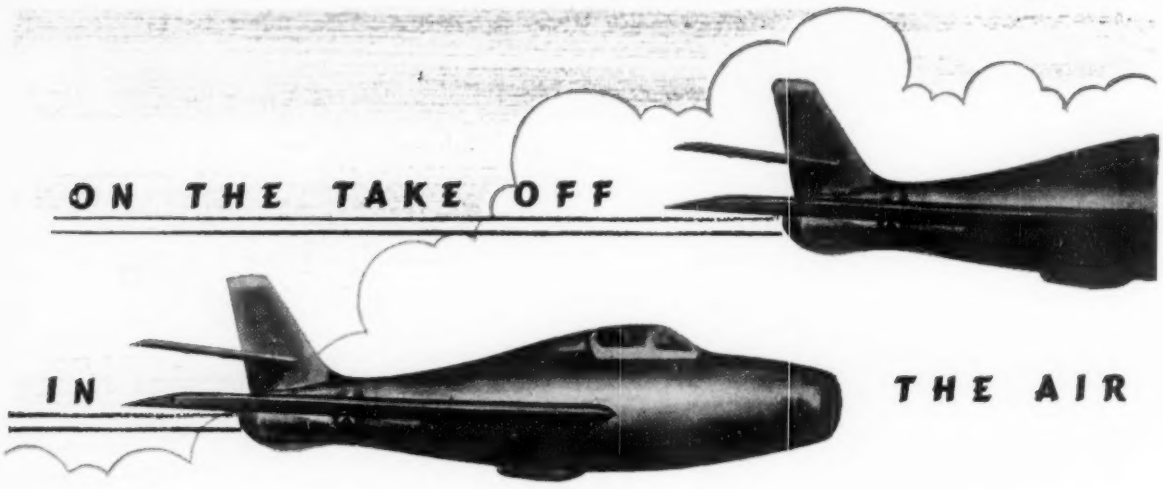

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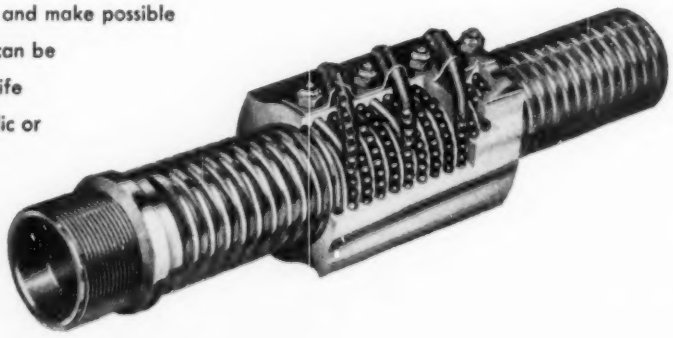

**Saginaw STEERING GEAR DIVISION**

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# AVIATION WEEK

Volume 61 No. 7
August 16, 1954

AIR MATERIEL COMMAND EDITION



■

AMC-Industry Gear for Swift Combat Support 70

■ MANAGEMENT

AMC Streamlines Management Pattern..... 71

■ THE AIR MATERIEL AREA

Supply at Grass-Roots Level..... 82

■ THE SUPPLY DEPOT

How AF Operates Huge Hardware Chain.... 88

■ PROCUREMENT

Industry Helps Carry Weapons Systems Ball. 92
AMC Planners Phase Weapons Systems.....105
Reshuffle Clears Procurement Channels....106
Court Double-Checks AMC Contracts.....111
How AMC Fights Fraud.....116

■ LOGISTICS

Airlift Helps AMC Cut Logistics Knots.....140
How AMC Fills Overseas Lifeline.....153
Electronics to Streamline AF Logistics.....154
Packaging Keeps Pace With Air Cargo.....167

■ PRODUCTION

How an AMA Speeds Weapons Production..178
How AF Runs $10.6 Billion Spares Setup..199
Surgeon's Job: Fight AF Health Hazards...217
Gearing Industry for Fast M-Day Start....223

■ MAINTENANCE

Keeping Them Flying Is Big Business.....234
SAM-SAC Keeps B-36s Ready to Go.....264
Tinker Makes Jet Engines Good As New....278

■ AVIONICS

Competition Gets Keener in Avionics.....289
Gentile Keeps AF Avionics Operational....292
Personnel.....302

■ SPECIAL FEATURES

Aerial View of Wright-Patterson AFB..... 72
USAF Procurement Program..... 75
AMC Expenditures Fiscal 1950-54..... 77
AMC Installations Map..... 78
AMC Headquarters Organization Chart..... 80
AMC Field Organization Chart..... 87
Weapons Systems Contracting Methods..... 94
Weapons Systems Development and Logistics Chart..... 98
Weapons Systems Project Offices Team Captaincy..... 102
Procurement Division Reorganization Chart.107
AMC Plant Representatives List.....135
USAF Spares Program Tables.....199
Maintenance Division Organization Chart...254
Who Buys What for USAF.....305
AMC Buyers List.....311
Prime AMA and Depot Responsibilities by Property Classes.....314
News of the Week.....376


**AMC DOCUMENTARY REPORT**

*This special Air Materiel Command issue of Aviation Week was prepared, for both the Air Force and the aircraft industry that serves it, as a documentary report on the profound and far-reaching changes now in process for weapons systems procurement, global logistics and maintenance and modernization techniques.*

*Aviation Week editors and staff writers traveled 40,000 miles, most of it by air, in executing this assignment and personally interviewed hundreds of Air Materiel Command officers, civilians and aircraft industry executives. In this effort they received complete and effective cooperation from Gen. Edwin W. Rawlings, AMC Commander, and his staff.*

*Robert B. Hotz, executive editor, was editorial director of this special project, assisted by Frank Shea, Jr., associate editor.*

■ EDITORIAL INDEX ..... 391

# AMC-Industry Gear For Swift Combat Support

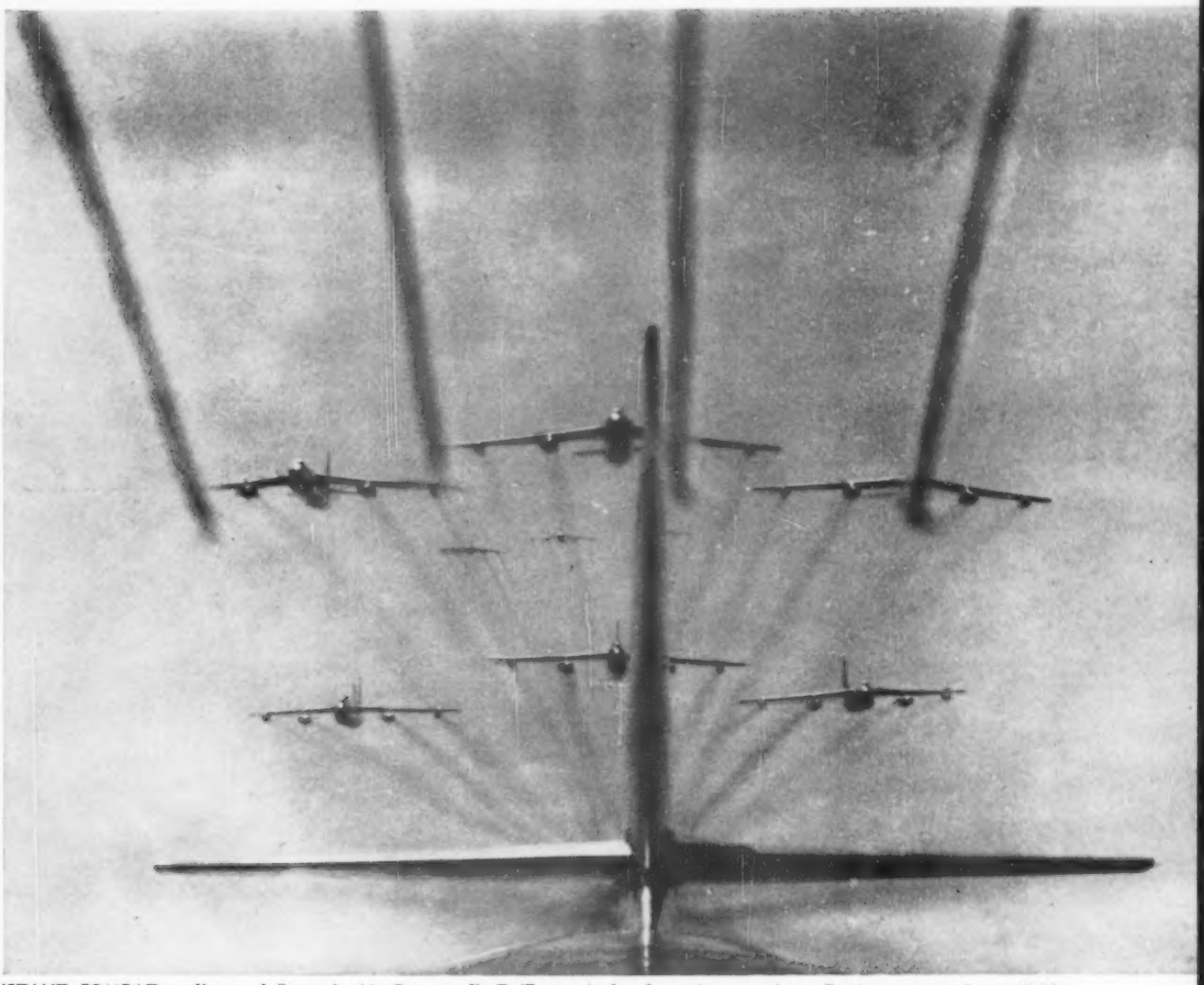
**PRESENT NATIONAL POLICY** has defined air power, combined with nuclear power, as a primary force in the defense of our nation and the free world. *This must be air power in being*, ready to strike back immediately and decisively.

**AIR MATERIEL COMMAND**, as the logistics arm of the Air Force, exists for the sole purpose of keeping the operating units of the Air Force supplied with the quality and quantity of weapons and equipment essential to victory—and with efficiency and economy. To meet the responsibilities of present national policy we are having to gear all of our activities to the lightning realities of modern air warfare.

**THE MAGNITUDE OF THIS TASK**, which is recognized by us, has intensified our efforts. Our program to keep logistics in step with technological improvement and evolving military strategy is always a primary goal. Our present three-fold program is only one of many assuring this accomplishment. Our first objective is to get and to keep all of our available resources in constant readiness. Secondly, we are aiming at adequate, simple but faster logistical procedures throughout our operations. Thirdly, we are working to reduce both the time element and the cost of essential equipment in our logistical pipelines.

I am confident that with the continuing support of industry, which is the arsenal of American air power, we can achieve this. We CAN give our fighting Air Force units the support with which the strength and striking power for freedom CAN be maintained.

E. W. Rawlings, General, USAF
Commander, AMC



**INSTANT COMBAT** readiness of Strategic Air Command's B-47 atomic bomber wings requires effective support from AMC.

# AMC Streamlines Management Pattern

By Robert Hotz

**Dayton—The Air Materiel Command is in the midst of a managerial revolution that is changing its basic pattern of doing business within the Air Force and externally with the aircraft industry from which it buys weapons systems and supporting equipment.**

AMC's managerial revolution is aimed at helping to solve two relatively new problems faced by USAF.

They are:

• **Necessity for building and maintaining an adequate combat force in being, ready to fight at once.** This means AMC must support what is essentially a wartime Air Force within the framework of a peacetime economy.

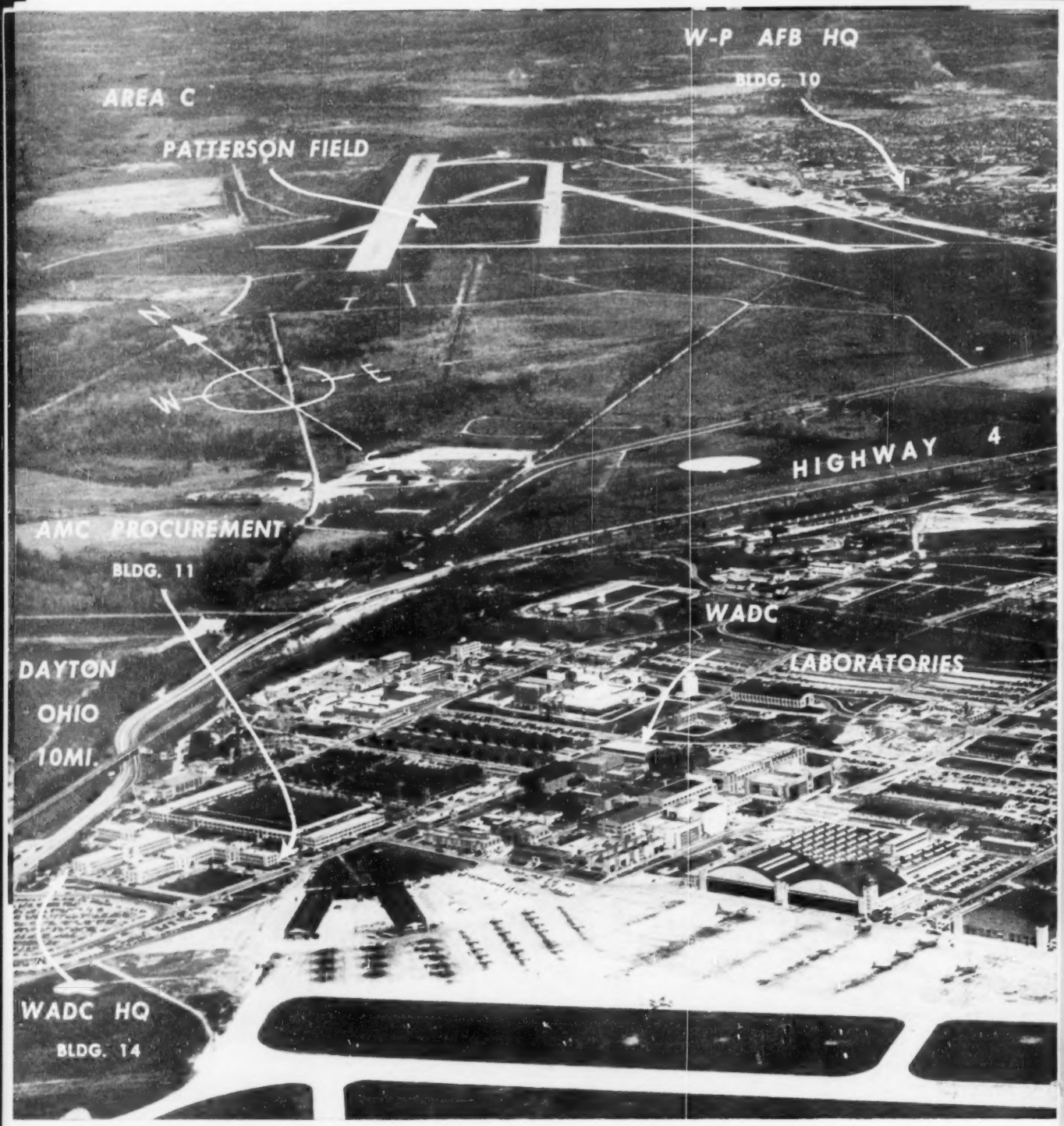
• **Radically changed character of aerial warfare stimulated by swift advances in aeronautical and nuclear weapons developments** that makes it possible to deliver incredible devastation across intercontinental range at supersonic speeds. This requires AMC's production and logistics support for USAF combat forces to match the speed and intensity of modern air war.

"Aerially speaking, World War II was a shotgun blast at the enemy," says Gen. Edwin W. Rawlings, AMC commander. "We peppered every part of him we could reach with an enormous and relentless quantity of planes and bombs. It was a stockpile war and it was the last of its kind.

► **Quality Decides**—"Any future major conflict will feature long-range sharpshooting on a gigantic scale. The payoff in modern air power is not so much for quantity as it is for quality and quick concentration of force. This can be achieved only through the soundest management of our necessarily limited resources for defense."

It is AMC's job to develop and provide that "soundest management" for the Air Force share of the "necessarily limited resources for defense."

It is AMC's job, teamed with the Air Research and Development Command, to provide the best balance of quality and quantity in USAF's arsenal of combat-ready aerial weapons systems.




**SPRAWLING ACRES** of Wright-Patterson AFB house AMC Hq. where multi-billion-dollar business is managed to procure, supply and maintain

► **Support Mission**—And it is also AMC's job to provide the proper logistic support to maintain USAF's globe-scattered combat forces in a state of constant readiness to fight, plus the ability to continue that support at maximum effort through the initial and most intense phase of any future conflict.

The work of AMC is a major step in the long and difficult process of converting national resources into superior military air power. Its procurement, supply and maintenance operations fill the middle of USAF spectrum, linking research and development at one end with combat units at the other.

To do this job AMC operates the largest business in the country within a framework of legislative and regulatory restrictions that would doom any civilian management to frustration and bankruptcy. AMC has total assets of $30 billion—$6 billion more than the combined total of the two largest private corporations in the country, Metropolitan Life Insurance Co. and the Bell Telephone System.

► **1954 Business**—Here is some of the business AMC did during fiscal 1954:

• **Spent $11.4 billion,** of which more

USAF aerial weapons systems. ARDC liaison is in Area B with Weapons System Project Offices.

than $8 billion bought weapons systems and hardware required by USAF. Since the outbreak of the Korean war in mid-1950, AMC has spent $25 billion to put muscle on the under-nourished skeleton of USAF combat wings.

• **Carries contracts** currently on its books with hundreds of American firms for future delivery of $17-billion worth of USAF equipment.

• **Overhauled 27,500 aircraft engines** and reconditioned 4,512 aircraft.

• **Shipped 4½ million tons** of supplies to 300 USAF bases and 1,800 other military installations around the world.

• **Stocked over 800,000 types** of items in depots containing 50 million sq. ft. of storage space.

• **Processed 39 million supply items** through its domestic and foreign depots.

► **Dominant Threads**—There are three dominant threads woven throughout the pattern of AMC's changing methods:

• **Speed**—because AMC must pull against the widening gap between the longer development cycle required for more complex aerial weapons systems and the increasingly urgent need of combat forces for equipment superior to the enemy's. AMC must also gear its support and supply operations to the supersonic pace of air combat.

• **Economy**—because AMC must get the maximum in air combat strength out of every dollar, machine tool, production worker, pound of material and plant allotted USAF from its share of the national resources.

• **Decentralization**—because AMC's job has grown so large and complex that it can no longer be operated from a single spot. And even if it could, the growing threat of long-range enemy air attack makes it militarily unsound to concentrate this operation where a single atomic bomb could obliterate it.

"Decentralization is working for AMC—as it has worked before for industry," says Gen. Rawlings. "Our philosophy of decentralization is aimed at maintaining centralized controls in AMC headquarters and decentralized operations in our Air Materiel Areas and Depots."

Decentralization of AMC began in January 1952 with the appointment by Gen. Rawlings of an ad hoc committee to study the problem. The committee was composed of senior AMC officers and materiel experts from USAF headquarters. At that time, AMC was swamped with the flood of procurement dollars that followed the frantic military appropriations after Chinese intervention in the Korean war.

► **Why Decentralization?**—The immediate factors influencing decentralization were:

• **Critical overcrowding** of the facilities of Wright-Patterson AFB.

• **Lack of proper technical** personnel in the Dayton labor market in the quantities required by AMC's expanding workload.

• **Strangling of AMC headquarters** in a tremendous volume of paperwork and red tape generated by the flow of all problems from the field to Dayton for solution and decision.

• **Neglect of policy-making** and plan-

ning activities at AMC headquarters because of the workload imposed by combining staff and operating functions in Dayton.

For the future these considerations were important:

• **AMC required an expansion capacity** to meet future emergencies and this could not be obtained from the overcrowded facilities at Wright-Patterson AFB or the badly drained Dayton labor market.

• **AMC headquarters presented** too strategic and vulnerable a target for enemy air attack, with all of USAF procurement, production, supply and maintenance operations concentrated in the confines of Wright-Patterson AFB.

AMC planners studied several of the largest U. S. industrial organizations such as Sears Roebuck & Co., General Motors Corp. and Ford Motor Co. All of these organizations were much smaller than AMC but all had turned toward decentralization of operations managed by central policy control as an effective solution to their continuing growth problems. The basic AMC decentralization policy that emerged from the committee study followed this principle that had been pioneered successfully by big business.

▶ **Field Assignments**—In the first phase of AMC decentralization the headquarters at Wright-Patterson AFB began peeling off operational functions and assigning them to AMC field organizations—the air materiel areas and the depots. AMC headquarters sought to retain only the functions of policy making and management control. Under decentralization the air materiel areas and the depots assumed a more important role in discharging AMC responsibilities.

The air materiel areas became similar to the operating divisions of a large decentralized private business with all of their functions such as overhaul, maintenance, supply, contract, administration and procurement under a single management that had the authority it required for its particular operations, but working under the central policy and management control of AMC headquarters.

Biggest effect of decentralization was felt in the procurement function of AMC where its Procurement and Production Division located in Area B at Wright-Patterson was swamped under a mountain of paper work resulting from the effort to get the USAF production program in high gear after the beginning of the Korean war. AMC shifted 80% of its procurement paper work to the field organizations, leaving the procurement people in AMC headquarters free to concentrate on the remaining and most important 20%.

**LT. GEN. BRYANT BOATNER,** deputy USAF chief of staff for materiel.

**ROGER LEWIS,** assistant secretary of Air Force, specializing in materiel.

AMC headquarters retained buying responsibility for all aerial weapons systems, aircraft engines, propellers and all government-furnished aircraft equipment and other highly technical items requiring considerable engineering support. These items accounted for 80% of AMC's procurement dollar volume, but because they are high-cost items they involved only 20% of the paper work.

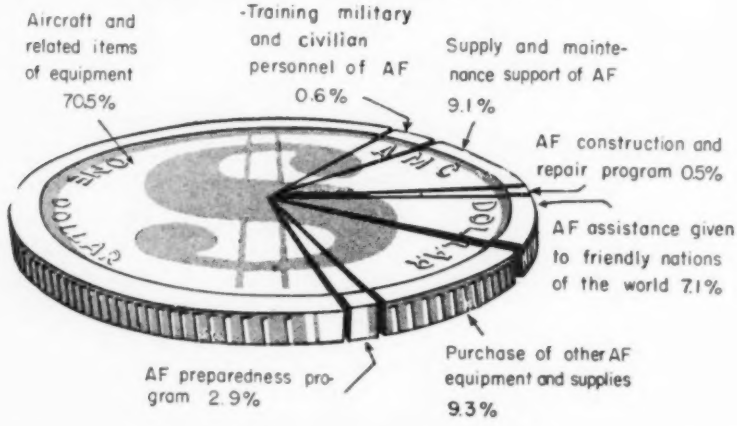
The procurement authority shifted to the air materiel areas and depots involved only 20% of the AMC dollar volume, but since it covered a large quantity of relatively low-cost items it generated 80% of the procurement paper work.

AMC field installations were delegated specific authority for handling procurement of items on the AMC qualified products approved list, standard-specification items and for spare parts required for continuing support of aircraft and equipment already in service (as distinguished from initial spares purchases for new programs that still are handled in AMC headquarters).

▶ **Local Purchase**—A third method of procurement known as the local purchase policy also has eased the AMC administrative load by replacing centralized issue of basic housekeeping supplies from depots with the authority for USAF installations in the field to buy their own housekeeping items from standard commercial suppliers. This policy has been operating at many USAF installations and will increase in volume in the future.

Total of 150,000 standard commercial items such as light bulbs, paint brushes, nails and paint are now authorized for direct local purchase by using agencies instead of having to grind through the AMC mill of mountainous paper work.

## HOW AMC SPENDS THE TAXPAYER'S DOLLAR


Aircraft and related items of equipment 70.5%
Training military and civilian personnel of AF 0.6%
Supply and maintenance support of AF 9.1%
AF construction and repair program 0.5%
AF assistance given to friendly nations of the world 7.1%
Purchase of other AF equipment and supplies 9.3%
AF preparedness program 2.9%

► **Major Procurement**—It is obvious that the decentralization of procurement involving 80% of the paper-work load has left AMC headquarters more time and effort to concentrate on the most important phase of its buying activities—the purchase of complex and expensive aerial weapons systems and their supporting sub-systems. It has enabled AMC to accelerate its buying process in the area where production lead time, proper pricing and technical superiority are most important.

AMC headquarters also retains procurement responsibility for aircraft and GFAE furnished foreign countries under the MDAP program and under the reimbursable foreign program that allows approved countries to buy military aircraft with their own funds at the same price USAF pays.

## Central Aircraft Buying

Another reason for the retention of aircraft, engine, propeller and GFAE buying at AMC headquarters is the close physical proximity of the Procurement and Production Division of AMC and the technical laboratories of Wright Air Development Center in Area B of Wright-Patterson AFB.

► **Focal Point**—The engineering support of WADC is required for AMC weapons systems procurement. AMC and the Air Research and Development Command have established the joint weapons systems project offices in Area B to provide industry with a single focal point for its contacts with USAF on each particular weapons system during the development and production phases.

To decentralize its supply operations, AMC assigned prime responsibility for some 250 USAF property classes to its field units. These assignments were made on a commodity basis. For example, the Gentile Depot was given responsibility for all airborne avionics; Warner Robins Air Materiel Area got all armament; petroleum was assigned to Middletown; textiles, rubber, clothing and printing went to Wilkins Depot; hand tools, bearings and mess equipment were assigned to Mallory Depot. The air materiel areas also were given prime responsibility for handling the aircraft, engines and parts for specific manufacturers. For example, all North American planes and parts are handled through the Sacramento Air Materiel Area; all Pratt & Whitney Aircraft piston engines are the responsibility of the San Antonio Air Materiel Area; the Oklahoma City AMA has prime responsibility for Boeing products.

This gives the major airframe and engine manufacturers a single point of contact on their supply, support and maintenance problems for their equipment just as the joint AMC-ARDC weapons system project offices in Area

## USAF PROCUREMENT PROGRAM

FISCAL YEARS 1953-55*

| ** | Obligations Fiscal 1953 (Actual) | Obligations Fiscal 1954 (Estimate) | Carry Over to Fiscal 1955 (Estimate) | New Money Approved Fiscal 1955 | Obligations Fiscal 1955 (Estimate) |
|---|---|---|---|---|---|
| **AIRCRAFT AND RELATED PROCUREMENT:** | $9.221 | $5.711 | $1.645 | $2.760 | $4.405 |
| (1) Aircraft, complete | 6.286 | 2.499 | 363.2 | 1.996 | 2.360 |
| (2) Initial aircraft component spares and parts | 1.756 | 1.236 | 861.1 | 175.9 | 1.037 |
| (3) Related aircraft procurement | 645.7 | 849.1 | 178.0 | 104.0 | 282.0 |
| (a) Industrial machinery, equipment, facilities | 195.1 | 276.9 | | | 45.00 |
| (b) Training items | 69.48 | 34.92 | | | 18.00 |
| (c) Aircraft ground-handling equipment | 189.2 | 153.1 | | | 65.00 |
| (d) Preproduction costs | 124.5 | 238.7 | | | 114.0 |
| (e) Service test materials | 67.40 | 145.4 | | | 40.00 |
| (4) Modification of inservice aircraft and component equipment | 217.5 | 371.0 | 37.00 | 142.2 | 180.0 |
| (5) Guided missiles | 243.6 | 678.4 | 204.9 | 265.1 | 470.0 |
| (a) Guided missiles, complete | 162.8 | 374.2 | | | 303.4 |
| (b) Initial component spares and parts | 14.92 | 25.03 | | | 23.45 |
| (c) Preproduction planning and facilities | 15.02 | 128.5 | | | 61.08 |
| (d) Modification and modernizations | | 15.06 | | | 18.56 |
| (e) Auxiliary equipment | 13.98 | 133.5 | | | 71.45 |
| (f) Guided aerial targets | 36.89 | 2.051 | | | |
| (6) Industrial mobilization | 5.975 | 13.42 | | 15.00 | 15.00 |
| **MAJOR PROCUREMENT OTHER THAN AIRCRAFT** | | | | | |
| (1) Electronics and communication equipment | 388.1 | 435.2 | 100.0 | 305.0 | 405.0 |
| (a) UHF communications equipment | 44.03 | 38.27 | | | 1.906 |
| (b) Identification (IFF) equipment | 44.51 | 36.52 | | | 22.61 |
| (c) Command communications systems | 15.33 | 15.90 | | | 12.24 |
| (d) Navigational aid equipment | 28.65 | 75.44 | | | 28.69 |
| (e) Tactical electronics equipment | 136.9 | 184.6 | | | 184.0 |
| **MAINTENANCE AND OPERATIONS:** | | | | | |
| (1) Aircraft maintenance spares and spare parts | 347.9 | 250.7 | | | 400.0 |
| (2) Corrective maintenance of aircraft | 129.8 | 120.8 | | | 125.0 |
| (3) Aircraft fuel and oil | 468.4 | 418.4 | | | 560.0 |

*Source USAF Budget

**All figures in this table represent obligations not expenditures.

***All figures are in Millions

B of Wright-Patterson AFB give them a single point of contact on development and procurement problems.

► **Advantages**—AMC has great faith in the future development of these close AMA-industry relations on specific weapons system programs as an effective method of providing the speed and efficiency required to keep a modern aerial weapons system combat-ready and modernized to first-line effectiveness throughout its life in the USAF combat inventory.

Under decentralization, the air materiel areas and depots also compute all USAF requirements and budget data for the items assigned them for prime responsibility, handle all property accounting for them, control USAF-wide distribution on these items, determine surplus categories, and initiate procurement requests.

Applied to AMC's maintenance functions decentralization has shifted the handling of all unsatisfactory reports and publication of technical orders to the air materiel areas on equipment for which they have been assigned prime responsibility.

## Steps to Consolidation

The second phase of AMC's decentralization program began in 1953 and was aimed at elimination and consolidation of intermediate headquarters. Under this phase the following action was taken:

- Functions of the air procurement districts were absorbed by the air materiel areas.
- Six air procurement districts were eliminated.
- Seventh Air Procurement District that was operating experimentally at Middletown, Pa., was eliminated.

These actions saved AMC an annual rental of $400,000 for leased office space and a total of $250,000 in equipment no longer required. It added the following functions to the AMA:

- Contract administration for its region.
- Handling plant security clearances.
- Supervision of plant representatives offices.

### AMC REGULATION

**Basic USAF regulation defining AMC authority and mission is 23-2 dated Dec. 3, 1953. It defines AMC's mission as follows:**

**1. Provide overall logistical support for all activities and agencies of USAF as well as those additional activities designated by Department of Defense which are dependent on USAF for logistical support including MDAP.**

**2. Provide, establish, and control adequate, efficient, up-to-date systems of procurement, production, quality control, maintenance, transportation, traffic management, supply, and disposal for all aspects of logistics support for complete aircraft weapons system in or programmed for the USAF inventory.**

**3. Train specialized units for the accomplishment of specified logistics function in overseas areas and theaters and provide depot-level specialist training for cadre personnel of air depot wings and replacement personnel for overseas depots.**

The third phase of decentralization currently under way in AMC is aimed at further extension and refinement of the principles involved in Phase I and II.

Studies are continuing at AMC headquarters on the remaining operational areas there to determine if further decentralization is feasible and will speed progress toward AMC's goal of autonomous field operations tailored to perform specific missions providing better USAF support with less expenditure of resources.

► **More Consolidation**—Further consolidation of intermediate headquarters is also in prospect along with transfer of prime responsibilities for more property classes to the field and shift of more operational duties to the air materiel areas.

In two years the pattern of AMC's decentralization has become clear and it is possible to measure some tangible results achieved:

- Drastically reduced the flow of paper work between AMC headquarters and the field installations.
- Substantially speeded the flow of AMC's supply system to USAF user commands.
- Transferred some 760 tons of records from AMC headquarters to field installations.
- Enabled AMC to handle a greater workload with overall reduction in personnel.
- Established more effective relationships between AMC and the aircraft industry on procurement, production, modernization and logistical support of major aerial weapons systems.

Along with the decentralization program, AMC has pushed programs aimed at its other objectives of speed and economy. These projects will be de-

**NORTH AFRICAN-BASED F-86S,** roaring over desert sands, maintain combat readiness as result of AMC's logistical pipeline.

**ARCTIC-BASED F-94 STARFIRES** roam skies at northernmost perimeter of supply network, counting on AMC to keep them flying.

scribed in detail elsewhere in this issue.

▶ **Economy Drive**—Aimed at economy are:

• High-value program. By early 1954 AMC had separated all of the USAF inventory items into three cost categories and developed a special handling procedure for high-cost items (more than $500). These high-cost items comprise only 2.3% of the USAF inventory items but account for 41% of its dollar volume. By concentrating major attention on the small quantity of high-value items it is possible to achieve major savings in the most important part of the inventory. Before the high-value program became effective a 10-cent item got the same basic treatment as a quarter-million-dollar jet engine.

• Application of standard life insurance actuarial methods to jet engine life expectancy spans. Major reductions have been made possible in both production and overhaul programs for jet engines.

• Projects IRAN (inspect and repair as necessary) and SAM-SAC (special aircraft modification for Strategic Air Command). IRAN has cut costs of overhauling standard USAF workhorses such as C-47s, C-54s, B-25s to a fantastic degree while SAM-SAC has prolonged the useful combat life of the B-36 fleet far beyond its normal span and maintained a high degree of combat strength operational during modernization cycles.

• Jet engine minor field repair program that has lengthened overhaul intervals, kept engines operational longer and reduced overhaul costs substantially.

• Development of better production methods such as the heavy press program that enable the aircraft industry to produce better equipment faster and cheaper.

▶ **Speed Drive**—Aimed at more speed are:

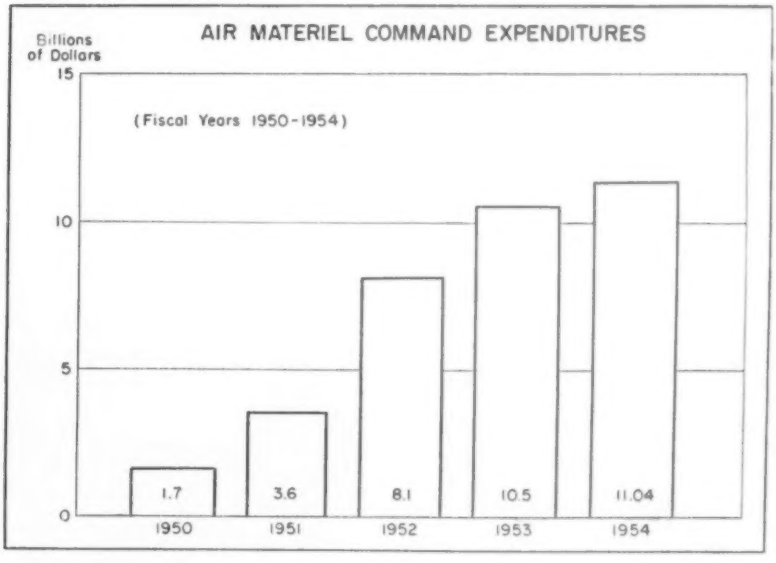
• Increasing utilization of direct airlift from supply source to USAF combat units for high-cost and strategically critical items such as jet engines, electronic gear and aircraft parts.

• Increasing use of business machines, electronic calculators and communications systems as a substitute for the time-consuming process of hand-shuffling supply papers.

▶ **Exciting, Vital**—The work of the Air Materiel Command lacks the glamor of research and development and has none of the excitement generated by air combat. It is done largely in the paper-shuffling of office buildings, the monotony of warehouses and the grease of overhaul shops. Yet to the leaders of this managerial revolution that is transforming the AMC slogan of "more Air Force per dollar" from a hope into reality, the operation of this gigantic enterprise is as interesting and exciting as it is vital.

These leaders represent a new type of senior officer that is emerging from the growing complexity of USAF operations. They are creators of the new science of military management in which they are merging the successful principles of industrial enterprise with the grim dictates of superior air combat strength.

Some of them, like Gen. Rawlings, have long years of active pilot service blended with Harvard Business School



training and years of seasoning in management of military materiel. Others, like Maj. Gen. Clarence S. Irvine, deputy commander for production, and Maj. Gen. Carl Brandt, director of maintenance engineering, bring a heavy flavor of combat operations into their approach to the problems of building and maintaining an Air Force in being.

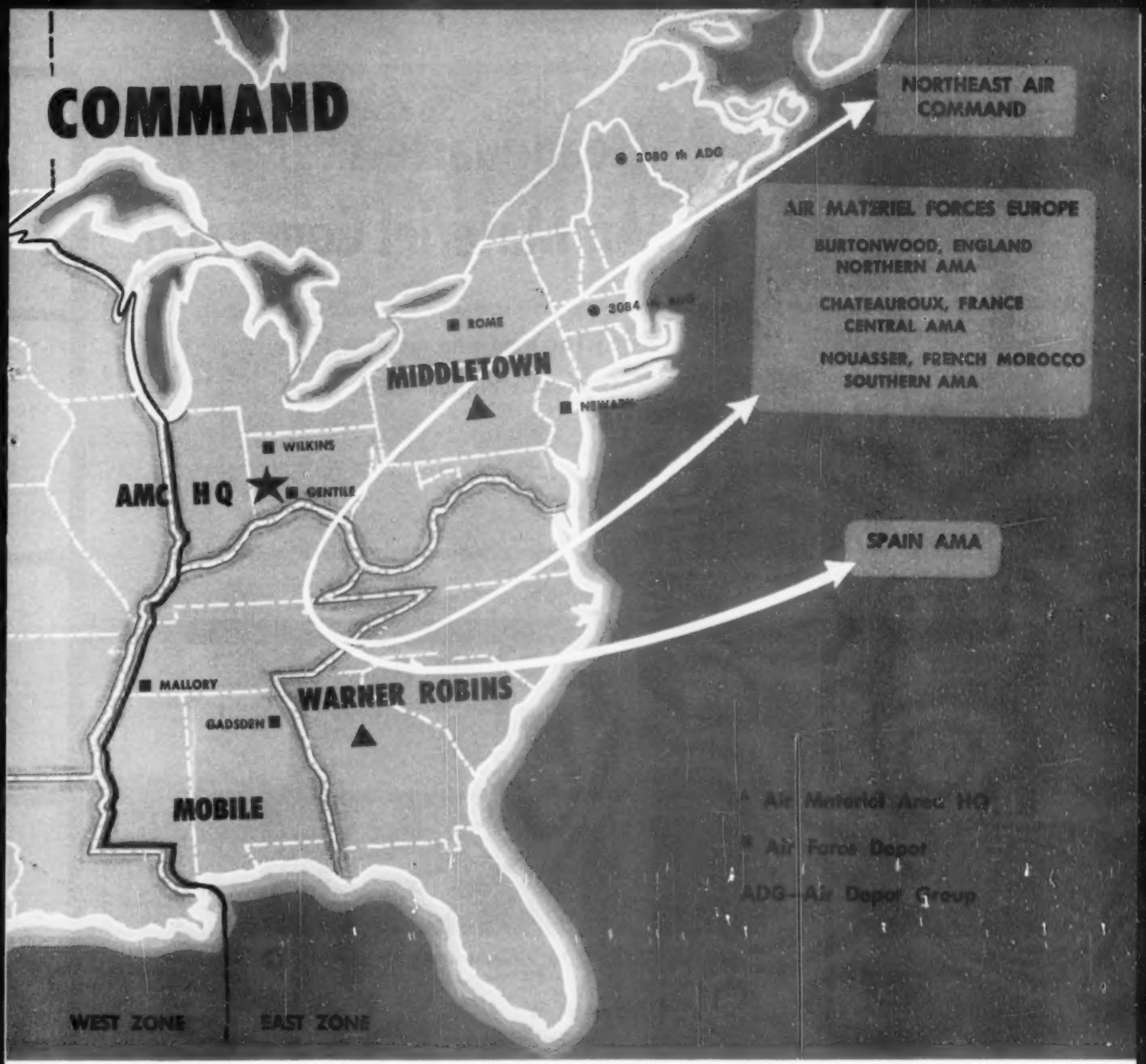
Some, like the brilliant Maj. Gen. Phillip Smith, who is a graduate of West Point, Massachusetts Institute of Technology and the Harvard Business School, and formerly an Army Ordnance officer, switched their talents to the fast-growing Air Force when it became a separate service. Others, like reservist Maj. Gen. Kern D. Metzger, temporarily left successful private business careers to pitch into the problems of USAF management.

## Industry Studies

Under its current leadership AMC has borrowed heavily from private industry for its management techniques where they could be successfully applied to the USAF problems. In some fields—use of electronic calculators for one—however, AMC is breaking new management ground and experts from industry are traveling to Dayton to see how these methods can be applied to their problems.

Key to AMC's management operations is the monthly executive control meeting attended by key staff members, all field commanders and presided over by Gen. Rawlings. Here "management by exception" is the rule with attention concentrated on the trouble spots and areas of substandard performance.

All AMC field installations are rated monthly on a competitive performance basis. When this competitive rating system began there was a spread of up to 25% in the performance of the top and bottom organizations. Now these competitions are decided by fractional percentages and there is an average spread of less than 5% between the top and bottom. Special trophies are awarded the air materiel area and depot




leading the pack in each quarter.

They are:

• Nelson Talbott Award to the AMA having the best performance in procurement and production. This trophy was donated by USAF Secretary Harold Talbott in honor of his brother, the late Brig. Gen. Nelson S. Talbott.

• Merrill Meigs Trophy for the AMA with the best overall performance, donated by "Babe" Meigs, Chicago publisher and aviation pioneer.

• Reed-King Trophy awarded the depot with the best overall performance and donated by Gordon W. Reed and H. O. King, industrialists who are extremely interested in AMC.

In the intense atmosphere of cost-consciousness that pervades every AMC installation, Gen. Rawlings sounds a note of warning:

"We in the Air Force must always keep in mind the sole purpose for which we exist," he said. "Our product is striking power ready to go the instant we are attacked. We are in being to prevent a war through strength if possible—to win one if it can't be prevented."

▶ **Cannot 'Sugar-Coat'**—"War and even the shadow of war is wasteful. We cannot sugar-coat that fact and we must not make the mistake of attempting to measure a striking force's combat efficiency purely in accounting terms. We must conserve our resources to insure sufficient strength to subdue an enemy. Consistent, common-sense economy is essential to such conservation.

"But it takes a high level of morale and esprit as well as the right equipment to make a first-class fighting force.

"We must not hamstring our people by attempting to make bookkeepers of fighting men or to insist on petty economies at an ultimate cost in combat efficiency.

"The next war could be decided in a matter of hours or days. In all our thinking and planning we must never lose sight of this possibility. We cannot put a price tag on those days because they are a precious natural resource literally beyond price." ■ ■ ■

# Headquarters Air Materiel Command

The men who manage the world's biggest business

COMMANDER
Gen. E. W. Rawlings

VICE COMMANDER
Maj. Gen. W. F. McKee

DEPUTY COMMANDER FOR PRODUCTION
Maj. Gen. C. S. Irvine

INSPECTOR GENERAL
Brig. Gen. B. I. Funk

SURGEON
Brig. Gen. E. J. Tracy

ASST. FOR SPECIAL WEAPONS
Col H. C. Porter

EXECUTIVE
Col. J. T. Kingsley Jr.

OFFICE OF INFORMATION SERVICES
Col. E. G. Morrison

STAFF JUDGE ADVOCATE
Col. M. R. Tidwell, Jr.

ASST. FOR SPECIAL EVENTS
Lt. Col. J. B. Cross

ASST. EXECUTIVE FOR MANAGEMENT
Col. E. G. Prohaska

LEGISLATIVE LIAISON DIVISION
Col. J. R. Kerr

ADJUTANT
Col. M. J. O'Brien

CHAPLAIN
Chaplain (Col.) L. C. Habetz

QUALITY CONTROL
Col. C. F. Damberg

**DIRECTORATE OF PROCUREMENT AND PRODUCTION**
Maj. Gen. D. H. Baker

MANAGEMENT SERVICES OFFICE
Col. R. J. Marasi

OFFICE OF INSPECTION
Lt Col W. C. Robinson

OFFICE OF THE PROCUREMENT COMMITTEE
Mr. D. W. Burns

PROGRAMS AND ANALYSIS OFFICE
Col. Richard D. Ohlo

DEPUTY DIRECTOR PRODUCTION
Brig. Gen. Clyde H. Mitchell

DEPUTY DIRECTOR PROCUREMENT
Brig. Gen. Wm. T. Thurman

DEPUTY DIRECTOR MOBILIZATION PLANNING
Col. Vincent T. Connor

**DIRECTORATE OF SUPPLY AND SERVICES**
Brig. Gen. F. J. Dau

PLANS AND OPERATIONS
Col. O. Hooker Jr.

EQUIPMENT AUTHORIZATION DIVISION
Col. J. M. McCamobell

PROCEDURES AND FIELD OPERATIONS DIVISION
Col. J. W. Thacker

TRANSPORTATION AND PACKAGING DIVISION
Brig. Gen. J. L. Riley

PROGRAMS AND REQUIREMENTS DIVISION
Col. Rockwood

MATERIEL CONTROL DIVISION
Col. Glaser

AIR FORCE SERVICES DIVISION
Col. H. Moore

CATALOGING DIVISION
Col. Robins

**DIRECTORATE OF MAINTENANCE ENGINEERING**
Maj. Gen. C. A. Brandt

MAINTENANCE ENG'G PLANS AND MANAGEMENT DIVISION
Col. V. L. Anderson

RESEARCH AND ANALYSIS DIVISION
Col. C. W. Bunch

MAINTENANCE ENGINEERING SERVICES DIVISION
Col. M. L. Dyer

**DIRECTORATE OF PERSONNEL AND SUPPORT OPERATIONS**
Brig. Gen. A. V. Anderson Jr.

GROUND SAFETY OFFICE
Col. L. F. Carter

CIVILIAN PERSONNEL DIVISION
Col. J. W. Bowman

INSTALLATIONS DIVISION
Col. E. C. Gill

PLANS AND REQUIREMENTS DIVISION
Dr. W. A. Stumpf

OPERATIONS AND TRAINING DIVISION
Col. E. J. Rozewski

MILITARY PERSONNEL DIVISION
Col. G. V. Mimms

**COMPTROLLER**
Maj. Gen. P. W. Smith

MANAGEMENT ANALYSIS OFFICE
Col. W. R. Gray

ACCOUNTING DIVISION
Col. W. E. Carter

MANPOWER AND ORGANIZATION DIVISION
Col. E. R. Pearson

BUDGET DIVISION
Col. D. W. Veldink

FINANCE DIVISION
Col. J. H. McCown

STATISTICAL SERVICES DIVISION
Col. A. L. Johnson

CENTRAL PROCUREMENT FINANCIAL DIVISION
Col. W. H. Matthews

**ASSISTANT FOR PROGRAMMING**
Brig. Gen. F. H. Miller

ADMINISTRATION OFFICE
Maj. G. H. Adkins

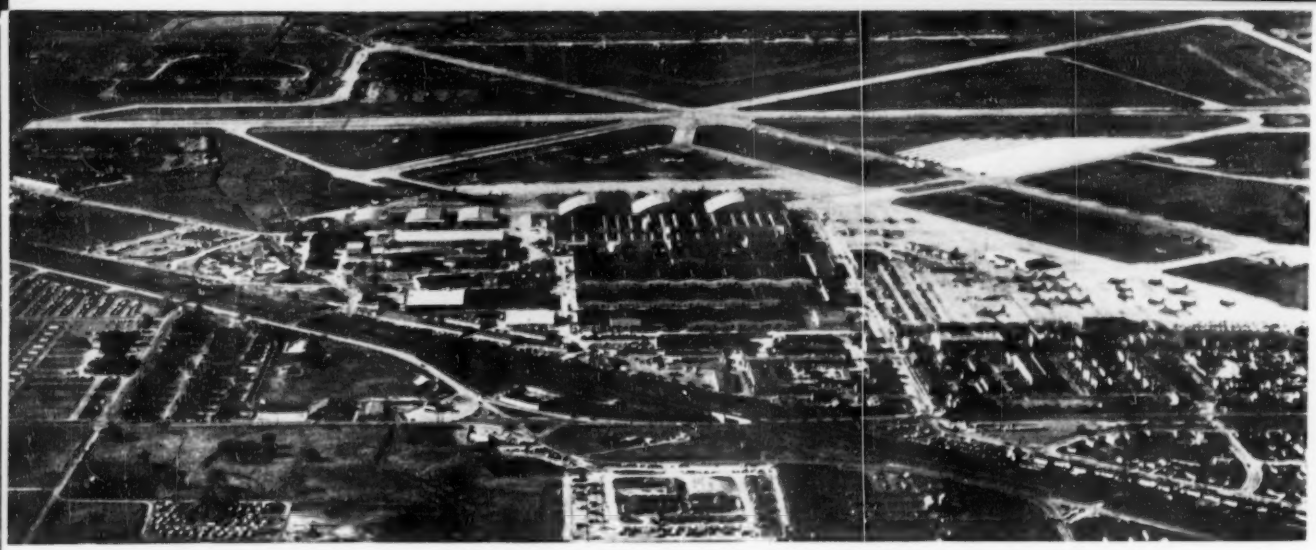
ANG AFFAIRS OFFICE
Col. J. L. Montague

PLANS DIVISION
Col. C. C. Andrews

PROGRAMS DIVISION
Col. R. A. Johnston

MUTUAL SECURITY DIVISION
Lt Col. A. J. Clocksin

LOGISTICS STUDY DIVISION
Col. H. T. King



**SACRAMENTO AMA** at McClellan AFB, AMC's distributor for entire Pacific area, typifies AMA's new role in decentralization.

# AMA: Supply at the 'Grass Roots' Level

By William J. Coughlin

Sacramento, Calif.—Decentralization relieves Air Materiel Command headquarters at Dayton of a lot of operational problems.

Those problems, unfortunately, do not just disappear. Decentralization means merely that they have been sent somewhere else.

The somewhere else is the eight AMC Air Materiel Areas and seven supply depots.

Decentralization of AMC functions, together with emphasis on the weapons systems concept, has brought added importance to these AMAs.

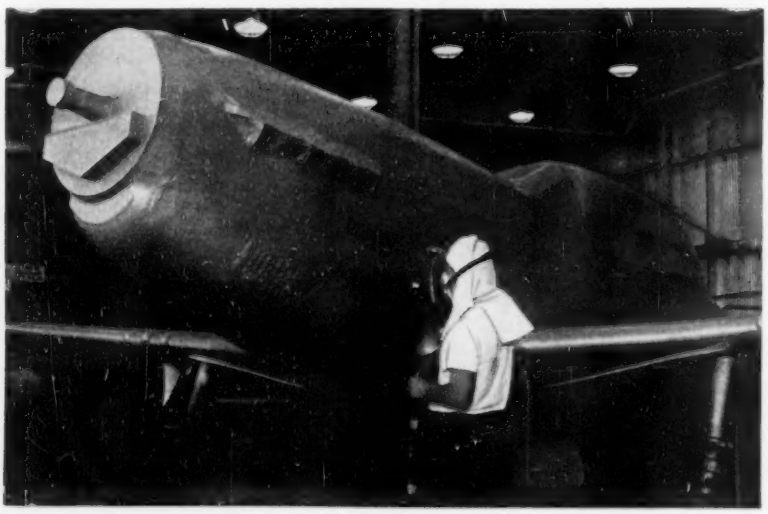
The Air Materiel Area, once only a supply depot for Air Force bases within its geographical area, now has acquired four important responsibilities.

► **Four Jobs**—When Brig. Gen. William T. Hefley, commander of the Sacramento Air Materiel Area (SMAMA), looks at a map, he can define the four areas of his responsibility geographically. Two are global, one encompasses a zone which covers more than half of the U. S., and the fourth is a region which includes Northern California, Northern Nevada, and the state of Oregon.

Under decentralization, each AMA is charged with:

- **World-wide logistic support** responsibility for assigned weapons systems.
- **World-wide management** responsibility for assigned weapons systems.
- **Zonal responsibility** for certain property classes.
- **Special logistic support** within the AMA's assigned geographic area.

Since one of AMC's four Overseas Logistical Control Agencies falls under his command, Gen. Hefley also has a fifth responsibility; the distribution of Air Force supplies to the entire Pacific area, including such hot spots as Korea and Indochina.



**FAR-EAST BOUND** F-51 Mustang is cocooned as part of extensive preparation for shipment.

## AMA's Big Jobs

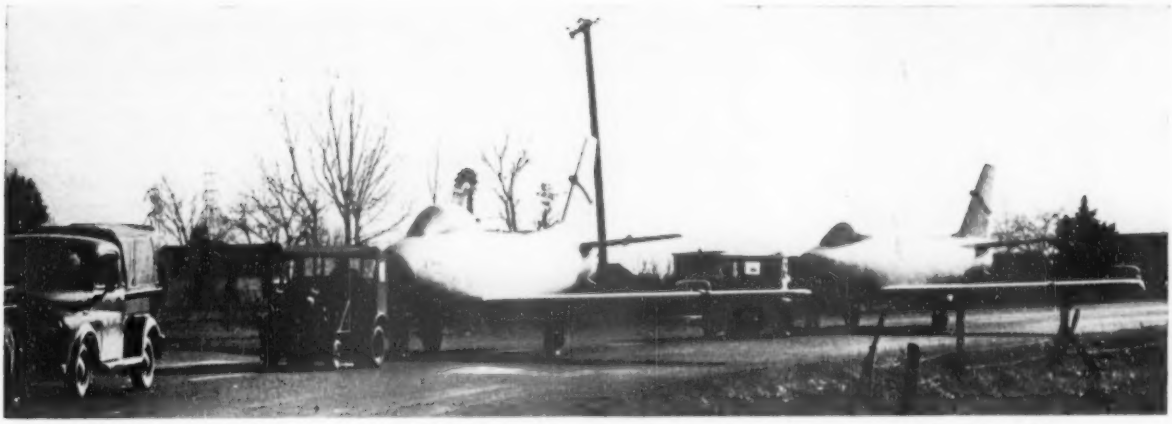
With the duties of each Air Materiel Area varying somewhat, no AMA can be said to be exactly typical of the other seven. But the Sacramento Air Materiel Area at McClellan AFB, one of the largest, serves as an example of the new role the AMAs play in the decentralized AMC organization.

Incidentally, like all alphabetized government agencies which lend themselves to the practice, AMA has become a word in the AMC language, usually pronounced to rhyme with "mama."

► **Prime Responsibilities**—Each AMA has been assigned prime responsibility for the products of one or more of the aircraft or engine manufacturers.

The Sacramento Air Materiel Area, for example, is prime in the products of North American Aviation and Lockheed Aircraft Corp.

For the operational commands, this provides a single point directly responsible for logistic problems of their aircraft. The AMA here at McClellan AFB works closely with the Air Defense



**LEAVING SMAMA,** cocooned planes are towed 10 miles, then barged to San Francisco embarkation point for ship loading.

Command, for instance, since most ADC aircraft are built by North American or Lockheed.

For the aircraft industry, this means closer cooperation from an Air Materiel Command organization specializing worldwide in the problems of the individual manufacturer.

Under this concept, for example, SMAMA is responsible for seeing that wherever the F-100 is operating in the world it has full logistic support for all components from the time of its first test flight until it is declared obsolete.

Therefore, while SMAMA does not have prime responsibility for the engine which powers the F-100, it must see that the AMA which does have the prime engine responsibility is prepared to provide proper logistic support for the North American aircraft.

▶ **Weapons Systems**—The Air Materiel Area has been assigned these specific responsibilities for its weapons systems:

- **Assisting AMC headquarters** in the development of logistic support concepts for assigned weapons systems.
- **Maintaining phasing charts** showing dates for accomplishing support actions.
- **Assuring logistic support** action by all AMC activities for its assigned weapons systems.
- **Solving any problems** of assigned weapons systems.

When the Air Defense Command found that performance of its North American F-86Ds and Lockheed F-94Cs was not as high as desired, it came to the Sacramento Air Materiel Area with its problem. Together with ADC and the manufacturers, SMAMA worked out an extensive modification program, now underway.

Although some of the modifications involved engines and fire control equipment on which other AMAs are prime, the Air Materiel Area here was charged with seeing that these problems on its assigned aircraft were worked out.

▶ **Assigned Property**—In its second area of responsibility, the AMA has prime responsibility for certain assigned property classes, such as auxiliary fuel tanks or electrical generator sets.

On these items the AMA is responsible for computing requirements for quantity and type items needed, for their procurement and production and for contract administration. It also must evaluate unsatisfactory reports (URs) and engineering change proposals (ECPs), as well as prepare technical orders and maintenance handbooks. The AMA must determine repair and modification requirements and schedule that workload to specific depots or contractors.

▶ **Zonal Basis**—For the purpose of assigning zonal responsibilities, AMC has divided the U. S. into eastern and western zones. On property classes for which it has zonal responsibility but for which an AMA in the other zone may be prime, the Air Materiel Area is charged with depot maintenance, storage and distribution, but escapes the management headaches.

## Local Support

The last of the four functions goes back to the original concept of an AMA—that of logistic support for the geographical area in which it is located. The AMA provides Air Force bases in its area with supply and maintenance support. If a problem arises where special assistance is needed for property classes or weapons systems which are the prime responsibility of another AMA,

**LOGISTICS MAP** in overseas monitoring office shows supply flow to Pacific and Alaska.

**BRIG. GEN. W. T. HEFLEY**
Commander, Sacramento AMA

the Air Material Area can call upon the other AMA to assist with the problem.

The AMA is responsible for solving any Air Force logistic problems within its area. This includes Reserve and Air National Guard activities.

▶**What It Takes**—What does it take to carry out all these functions?

At McClellan AFB, it takes an AMA which covers 2,000 acres of shops, warehouses, hangars and administration buildings. It requires 15,000 civilian employes and 800 AMC officers and airmen.

It takes a payroll of $65.5 million annually and a total operating cost of $105 million each year. It also requires an organization which expends $150 million annually to meet Air Force requirements on its prime classes.

SMAMA operates its own railroad—15 mi. of track with three locomotives. Someone has figured out that the paved area on the base is the equal of a three-lane highway from Sacramento to Reno, that the base telephone system handles 23,000 calls per day, that the base uses enough water each day for 35,000 homes, and that there are 2.2 million sq. ft. of warehouse storage space.

All of this for the one purpose which an AMC official calls "customer service"—to provide service to AMC customers, the operational commands of the U. S. Air Force.

## How It Works

Basic mission of the AMA under the weapons systems concept is to support logistically the operating commands with respect to the aircraft or other weapon for which the AMA is prime. How does this work when a command comes to the AMA with a problem concerning its aircraft?

An SMAMA spokesman describes the operation this way:

"We deal with the supporting depots, the engine depot, fire control depot, autopilot depot, and the support equipment depots, as well as the contractors, Air Research and Development Command, Air Proving Ground Command, and any other agency, as required, to relate the total logistical effort to the aircraft for which we are prime. This does not mean that SMAMA is superior to any other depot, for we, in turn, play a similar supporting role where an aircraft is prime at another depot and we are responsible for support classes."

Placing responsibility for logistical support of the weapons systems at the AMA level has placed heavy emphasis on the necessity for proper support planning. This means the AMA must continually review the logistical position of the aircraft from the design stage, through the building of a prototype or experimental model, to flight testing and production.

During service use, it must provide maintenance support through IRAN and modifications. Purchase of follow-on spares continues until the aircraft is phased out of service.

The AMA must have ready at the proper time the required spares, ground equipment and handbooks to support the operations of the command which uses the aircraft.

It must work with the using commands to determine the logistic needs based on the flying hours scheduled. It develops support plans for field maintenance. The plan for the F-100, for example, calls for very little repair of major assemblies in the field while the aircraft is overseas. Thus, to support this plan, SMAMA will order more assemblies than repair parts.

The Air Materiel Area also develops plans for depot level maintenance support. On Lockheed's RC-121, which will be flying on regular radar patrol schedules for Air Defense Command, an airline-type maintenance plan was worked out which will cut costs.

▶**Can AMC Do It?**—The AMA also must determine whether AMC is logistically capable of meeting requirements cited by the operating commands. For instance, North American recently toured major air command bases to demonstrate the T-28B.

If a command cites a requirement for this aircraft, SMAMA is ready to provide AMC or USAF headquarters with a study of the logistical requirements needed to support the T-28B.

This study had to take into consideration such factors as possible uses for old engines and old propellers and cost of airframe modifications required for existing T-28 aircraft. It required working with the engine depot at Middletown to determine the capability of converting to the Wright R1820 engine.

The completed package sets forth the amount of money needed to accomplish the conversion, as well as a proposed conversion schedule which could be handled by all the AMC depots which would be involved in such a program.

▶**Support Schedules**—Although the AMA is not responsible for scheduling of production of new aircraft, it is responsible for all logistical phasing in connection with its prime aircraft. Working from the production schedule, it must develop support schedules to provide guidance for other depots involved in support of that aircraft, such as the engine depot. The prime depot is responsible for seeing that these schedules are met.

And, of course, the AMAs must provide spare parts support for their prime aircraft. First release of production for spares is generally made 24 months in advance of the delivery of the first aircraft. The AMA also controls the selection of spare parts and the quantities which are to be purchased.

The Air Material Area also is responsible for action on unsatisfactory reports on its prime aircraft. Engineering change proposals are routed from the contractor through the prime aircraft depot. Thus, the AMAs work with the using commands and the manufacturers to keep their prime aircraft as up to date as possible.

## Planning Ahead

The AMA also works out IRAN schedules with the major commands. To do this, it must consider the flying requirements, when the using command can spare the aircraft, the contractor's recommendations on time between overhauls, as well as availability of overhaul facilities, either within the AMC system or at contract facilities. Coordination of such diverse factors requires skillful planning.

▶**Planning Experts**—In fact, skillful planning has become one of the most important functions of the Air Materiel Area commander. To assist him in this, he has the office of the Assistant for Programming, who is responsible for the close coordination of such elements of the command as the Maintenance, Supply, and Procurement directorates.

Since these directorates depend on common programming data to develop their own plans and schedules, the Assistant for Programming serves also as the single point of contact within the AMA for analyzing and disseminating program information. This office also is responsible for monitoring the implementation of weapons systems concepts by the directorates responsible.

The job of the Assistant for Programming, in the words of John M. Wynne, who serves Gen. Hefley in this capacity, is to be the general's "alter ego" in the planning area. If the duties of Wynne's 25-man office were summed up in one word, it might be: coordination.

The importance of this office may vary with each AMA. Gen. Hefley believes in delegating responsibility to

obtain the maximum assistance possible from this management tool. Elsewhere, another AMA commander might wish to retain more of the planning under his direct control.

▶ **Keeping Them Flying**—Gen. Hefley also has another group which aids him in carrying out his increased responsibilities under decentralization and the weapons systems concept.

Each week the base receives a report on any of its prime aircraft throughout the world which are out of commission due to lack of parts (AOCP) or are not fully equipped for their mission (ANFE).

The general has appointed a top-level committee to study these reports and take any action necessary to correct the situation.

"Their job is to prevent a $5-million aircraft from sitting on the ground for lack of a two-bit part," he says.

The committee, headed by the AMA inspector general, includes representatives from the maintenance, supply and procurement directorates, and from the weapons systems office and the office of the assistant for programming.

Gen. Hefley has found this top-level conference an excellent method for shortcutting across the functional lines of his command and breaking bottlenecks.

## AMA Directorates

To carry out its duties, the Air Materiel Area is divided along functional lines into three directorates: Maintenance, Supply and Procurement.

▶ **Maintenance Directorate**—Largest of the three at Sacramento is Maintenance, with 9,200 people under Col. Arthur C. Perry. Its long assembly lines can handle up to 200 aircraft of varied types per month on major overhaul.

The Maintenance directorate in turn is broken down into such branches as electronics, armament, engines and accessories.

Decentralization has been a boon to the maintenance shops, Col. Perry reports.

"Decentralization is a big help because we have control of the workload here now and we can eliminate the fluctuations—we can schedule a firm, smooth workload into our shops," he says.

Due to this control, the maintenance workload for Sacramento for fiscal 1955 already is entirely firm.

Decentralization also has brought added responsibilities, of course. As many as 1,000 unsatisfactory reports for prime equipment now are processed here each month.

"But we can analyze these better and faster and take corrective action faster than before," Col. Perry reports. "This speeds production-line changes as well as retrofits."

Engineering change proposals from the manufacturer also are evaluated here, although requiring Wright Air Development Center approval. Thus, aircraft IRAN and modernization programs often can include changes other than those suggested by the using command through URs and accident reports.

"We are concerned with having the best product possible for our customers," is the way one AMC official puts it. A large part of that concern falls on the Maintenance directorate.

▶ **Supply and Procurement**—Supply and Procurement are in a somewhat different end of the business from Maintenance. If you ask a Supply man about the Procurement directorate, he will tell you it is a "tool" which Supply uses to buy the goods needed by its customers—the operational commands.

If you ask a Procurement man about Supply, he will point out that Supply is a "tool" used by Procurement to transport the goods to Procurement customers—the operational commands.

Either way, it is apparent that both exist for the benefit of the customer, that their joint task is to supply the major commands with the logistic support necessary to keep them in operation—whether it is a cake of soap or a jet engine.

## Field Support

Both Supply and Procurement differ from Maintenance in that their main function is off-base. The major functions of Maintenance take place right at McClellan AFB. But Procurement goes elsewhere to buy what is needed and Supply delivers elsewhere. Only in the warehouse stage—in what might be called its transition from procurement channels into supply channels—is it found here.

It is found in quantity, however. More than 280,000 items are stockpiled in McClellan's vast warehouses.

▶ **Supply's Job**—Under decentralization, Supply, which at SMAMA is under the

**PISTON ENGINES** for USAF aircraft flow through AMA maintenance workshops.

**TECHNICIANS REPAIR** flight boots from Pacific area, a SMAMA responsibility.

**CONTRACTORS' tech reps, shown here in Korea, pass field data on to AMAs.**

direction of Col. E. L. Ramme, is charged with both initial support and follow-on support of its assigned weapons systems and other prime equipment.

When the decision is made to buy new or additional aircraft, the prime depot holds a provisioning meeting to decide what spare parts are required to support that aircraft for one year in service. These are delivered with the aircraft. This is known as initial support.

After the aircraft has been in service, Supply re-estimates the parts that recent experience has indicated will be needed for the number of flying hours projected for the aircraft. It asks Procurement to buy these. The using commands then requisition these parts as needed. This is follow-on support.

The system, based on consumption, operates on requisition. Where commands in the field operate on 45-90-day supply basis, the depot is on a yearly basis. Present supply inventory at McClellan is estimated at $600 million.

Supply has the responsibility of seeing that the USAF commands have everything they need to exist and accomplish their mission. These supplies do not always come from Air Force channels. The Quartermaster Corps is expected to supply food for the Air Force, for example, and USAF obtains its .45 caliber sidearms from the Army. Thus Supply may use different tools to fill its responsibilities. In one case, it may use its own procurement branch; in another, it may turn to another service. In each instance, however, Supply must monitor the results.

As noted above, to fulfill its global responsibilities under the weapons systems concept, this depot is kept informed of every item which is preventing one of its prime aircraft from flying, wherever it might be in the world. Whether this is due to shortage of an item or a malfunction, the AMA takes whatever action may be necessary.

"The using commands are getting the support they need faster under decentralization," reports a Supply officer. "It is a definite improvement."

▶ **Link With Industry**—The Procurement directorate, under Col. H. H. Tellman, is SMAMA's main link with the aircraft industry. This office is responsible for purchase of such items as North American and Lockheed spares, as well as the handling of contract administration, checking of quality control and monitoring of production schedules.

The directorate has four divisions:

- **Procurement.**
- **Contract administration.**
- **Production.**
- **Quality control.**

It also has prime staff responsibility for the Air Force plant representative offices at Lockheed and North America, for the San Francisco Air Procurement District, and AMC's Palmdale office.

Of the 500 directorate employes, 300 are stationed elsewhere. The plant representative's office at North American has 140, at Lockheed 120.

The directorate's procurement division spent $45 million last year, $10 million of it on so-called local purchase items which AMC permits its units to buy in their own geographical areas. The rest went for North American and Lockheed spares, prime items such as fuel tanks and printing equipment, and civil maintenance contracts.

▶ **Procurement Merger**—Last October, AMC eliminated its procurement districts by merging them with the Air Materiel Areas. The Western Air Procurement District, for example, was split in half, with one section assigned to the Sacramento Air Materiel Area and the other to the San Bernardino Air Materiel Area. The former regional offices in San Francisco and Los Angeles were re-named "procurement districts."

AMC thus consolidated two of its field organizations, the AMAs and the procurement districts. Although a consolidation rather than a decentralization, the move fell into the pattern of increased responsibility for the Air Materiel Areas and at the same time eliminated a number of administrative housekeeping functions.

It also brought the field procurement operation into closer contact with the depot operation, resulting in improved relations with such AMA functions as supply, maintenance and procurement.

It has resulted in what one official calls "a cross-education which benefits everybody."

Although the San Francisco Air Procurement District, like the plant representative and Palmdale offices, falls administratively under the Procurement directorate, it reports directly to AMA headquarters.

▶ **Contract Watchdog**—The directorate's contract administration division is responsible for administration of all AMC contracts in this area, regardless of what AMC depot does the actual buying. In addition to administering the contracts for its prime North American and Lockheed aircraft, it also is responsible for administering contracts which the Rome depot, for instance, might sign with an electronics manufacturer in San Francisco.

This division is charged with such functions as approving the cost system of the contractor, approving his buying procedures on cost-type contracts, seeing that government-furnished property is accounted for properly, ascertaining that the contractor is paid, and drawing up termination agreements at the end of the contract. It also handles some phases of price redetermination when necessary.

The directorate's production division is responsible for seeing that AMC contractors meet their production schedules. To do this, it must be certain that the contractor gets the proper priorities, and that he is getting the right type and quantity of government-furnished machinery if called for in the contract. One of the important duties of this division is planning for industrial mobilization in event of an emergency.

▶ **Quality Inspectors**—The quality control division maintains a surveillance-type control. In World War II, the Air Force re-inspected almost everything the contractor inspected.

Now AMC sets up the inspection plan and then spotchecks the operation.

▶ **Does Decentralization Work?**—How is decentralization and the weapons systems concept working at the Air Materiel Area level? Fine, according to Gen. Hefley, and further decentralization of operating functions can be expected. It has resulted in better personal relations with the contractors, he says, and more attention to the contractor's problems.

"We are able to put a higher level of talent on major problems," Gen. Hefley reports. "It is no longer one problem among many as it was at Wright-Patterson." The system pinpoints problems in this manner, just as it pinpoints responsibility for each weapons system.

This does not mean that the "bugs" are entirely out of the system yet. But most of the complaints heard here concern the need for more decentralization, not less. The AMA seems to be thriving on the new role which gives it increased responsibility and importance in the AMC organization. ■ ■ ■

# AMC FIELD ORGANIZATION

## *The Men Who Make Decentralization Work*

### AIR MATERIEL AREAS

COMMANDER
Gen. E. W. Rawlings

MIDDLETOWN AMA
Maj. Gen. L. P. Whitten
Olmsted AFB, Middletown, Pa.

SAN ANTONIO AMA
Brig. Gen. T. C. Odom
Kelly AFB, San Antonio, Texas

SACRAMENTO AMA
Brig. Gen. W. T. Hefley
McClellan AFB, Calif.

OGDEN AMA
Brig. Gen. M. E. Tillery
Hill AFB, Ogden, Utah

WARNER ROBINS AMA
Maj. Gen. K. E. Tibbetts
Robins AFB, Warner Robins, Ga.

OKLAHOMA CITY AMA
Maj. Gen. Wm. O. Senter
Tinker AFB, Oklahoma City, Okla.

SAN BERNARDINO AMA
Maj. Gen. E. C. Longmead
Norton AFB, Calif.

SPAIN-AMA
Brig. Gen. L. P. Dahl
APO 285

MOBILE AMA
Maj. Gen. F. R. Dent, Jr.
Brookley AFB, Mobile, Ala.

WRIGHT-PATTERSON AFB
Col. P. L. Barton
Wright-Patterson Air Force Base, Ohio

### AIR FORCE DEPOTS

GENTILE AIR FORCE DEPOT
Col. L. G. Mulzer
Wilmington Pike, Dayton, Ohio

ROME AIR FORCE DEPOT
Col. M. F. Summerfelt
Griffiss AFB, Rome, N. Y.

WILKINS AIR FORCE DEPOT
Col. G. C. Thompson
P. O. Box 524, Shelby, Ohio

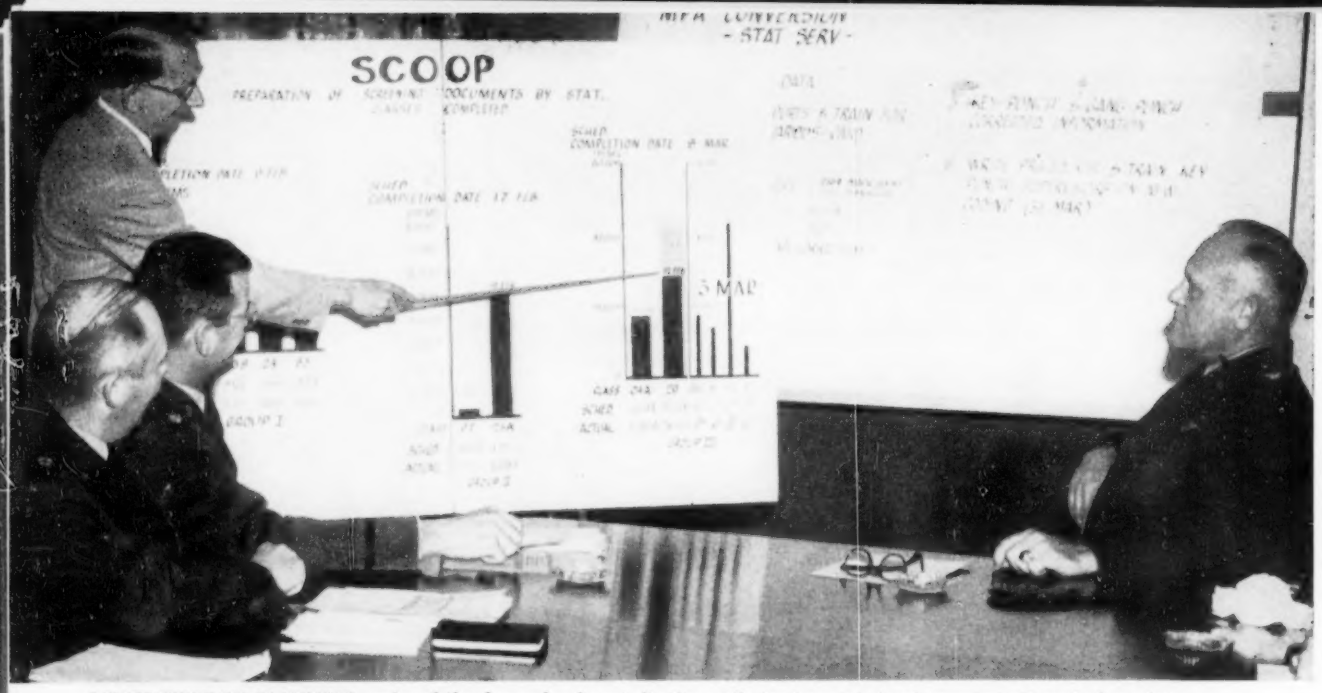
NEWARK TRANSPORTATION
CONTROL DEPOT
Brig. Gen. D. H. Alkire
480 Delancy St., Newark 5, N. J.

TOPEKA AIR FORCE DEPOT
Lt. Col. C. J. Popik
Topeka, Kansas

MALLORY AIR FORCE DEPOT
Col. W. P. Sloan
330 Jackson Ave., Memphis, Tenn.

CHELI AIR FORCE DEPOT
Col. W. S. Lee
Los Angeles County, Calif.

GADSDEN AIR FORCE DEPOT
Col. S. J. Zoller
Gadsden, Ala.




**LOWER-ECHELON PLANNING,** order of the day under decentralization, calls for frequent depot management control meetings.

# How AF Operates Huge 'Hardware Chain'

By Gordon Conley

**Topeka—Air Materiel Command is operating the world's largest chain of "hardware stores," each doing a multi-million-dollar business. But they serve only one customer—the U. S. Air Force.**

Across the counter, AMC's seven Air Force depots each handles an estimated 20,000 to 23,000 tons of aircraft spares and military "housekeeping" merchandise monthly for domestic and overseas USAF bases.

In the backrooms, they assemble kits that would allow Strategic Air Command squadrons to take off instantly on retaliation strikes and operate as self-supporting units for at least 30 days. The depots also prepare supplies for AF units to be formed in one to two years and forecast the amount of spares and equipment a new aircraft will need two years before the first model becomes operational.

▶**Slicing the Fat**—Storekeepers are mixed Air Force-Civil Service teams, who are making up a new book of rules and recommendations on military supply systems as they go along:

• In the past four years, these teams have taken over from AMC headquarters at Dayton the responsibility for determining USAF's requirements for prime stocks assigned to each depot.

• Six months ago, Topeka AFD, Kan., and Mallory AFD at Memphis, Tenn., began experimenting with a single-depot concept designed to make one installation, instead of the previous two, responsible for procurement, storage and world-wide distribution of certain non-combat materials.

Such reorganization as decentralization of Air Materiel Command headquarter's procurement authority and the single-depot concept resulted from AMC's search for ways to slice unnecessary fat from its operations.

To aid this effort, Air Materiel Command headquarters gives its depot teams a working flexibility similar to that of private industry and encourages field personnel to use initiative, imagination and exchange of ideas on how to set up a more effective support of the Air Force program.

"We're still on the alert for additional jobs at headquarters that should be transferred to the field," says one depot official.

## AFD Reorganization

Prior to 1950, AF depots were responsible only for storage and distribution of supplies. AMC headquarters at Dayton determined USAF's hardware needs and made all purchases.

▶**'Absentee Management'**—As one long-time AFD employe puts it: "We had absentee management with respect to determination of materiel requirements. Important decisions were being made elsewhere for us."

Under decentralization, depots now receive the Air Force program each fiscal year from AMC Hq., determine quantitative requirements, draw up purchase requests, call for bids and let contracts.

Each depot holds world-wide responsibility for its prime commodities.

Decentralization increased the efficiency of AMC's hardware procurement and supply system by letting depot personnel, familiar with the merchandise, compute USAF's requirements.

It also shortened the supply lines by cutting the length of time between determination of needs and delivery of materials to warehouse bins at each depot.

One major accomplishment to AFD workers: Depots now have increased stature within the AMC framework. "And because of that," says Lt. Col. C. J. Papik, Topeka, Director of Supply and Services, and acting commander, "we have a closer-knit sense of responsibility."

▶**'Bull Session' Idea**—The single-depot concept was proposed after a "bull session" of depot officials. AMC tentatively approved the idea, told Topeka and Mallory to begin a test last March.

Before the single-depot experiment, prime stocks handled by Topeka were

duplicated in Mallory's bins for shipment to USAF bases east of the Mississippi River; Topeka stored Mallory's prime commodities in addition to its own, handling all requisitions from the west.

The two Air Force depots now store no common items, each holding worldwide responsibility for its principal stocks.

"One depot can operate with a lot less stock than previously required for both Topeka and Mallory," Papik says. "I am firmly convinced this will result in dollar savings and increased efficiency. It will cut transportation and manhour costs and give better utilization of trained technicians."

▶ **War Preplanning**—In addition to handling prime commodities, each depot has started working on AMC's Readiness Reserve Program—an "automatic supply system" set up for immediate support of USAF units if another war should break.

"We recognized that we must have logistical supply packages ready to go immediately," says B. J. Poythress, formerly on AMC's Dayton staff and now deputy director of Supplies and Services at Topeka.

These include fly-away kits for SAC squadrons and air-transportable field depots assembled to open for business quickly after airlift delivery. Some are ready to go now; a few would take 24 hours.

"We are working toward having everything done—except filling in the addresses," Poythress reports. "The program is not fixed or final; it is undergoing constant revision to fit into planning at the Pentagon level."

Readiness Reserve also includes preparing ahead to supply new organizations still to be activated by the Air Force—a task nearly equal to war planning, according to one depot worker.

"Forecasting requirements for even the smallest unit requires a fantastic amount of detail," he says.

▶ **'Peculiar' Kits**—Under its Readiness Reserve tent, Topeka has a Special Project Branch to assemble medical kits "peculiar" to the Air Force. This operation is the only one of its kind in the country.

Technicians reduce the weight and cube of medical packages and send them down assembly lines to be made up into small, air-transportable infirmaries and dispensaries. Typical differences between these kits and normal equipment: cots instead of beds; inflatable mattresses and pillows rather than weighty, stuffed types.

Air Materiel headquarters set up the project after SAC found kits normally packed by medical personnel for airlift were cumbersome and heavy, and decided light, uniform packages were needed.

▶ **Production Reserve**—Another AF depot freak, found at Topeka and Cheli, is a project set up to supply plane builders with government-furnished aircraft equipment (GFAE).

In this division, Topeka and Cheli storekeepers build up reserves of armament systems, radio and radar sets, flight instruments, propellers, some engine components and other standard USAF aircraft equipment bought in volume by AMC for plane makers.

The two depots use these stocks to fill supply gaps when vendor production fails to keep up with aircraft assembly lines—certain accessories are always furnished the vendor—Topeka backing up pipelines east of the Rocky Mountains and Cheli supporting the west.

As one project official comments: "It can be expensive if an item is installed in an airplane out of assembly-line sequence. We try to make sure it isn't necessary."

This need for a constant flow to aircraft production lines sometimes puts pressure on the division's second responsibility: repair of equipment rejected by the airframe builders. Topeka and Cheli do little repair work at the depots, must send damaged and rejected parts to commercial contractors.

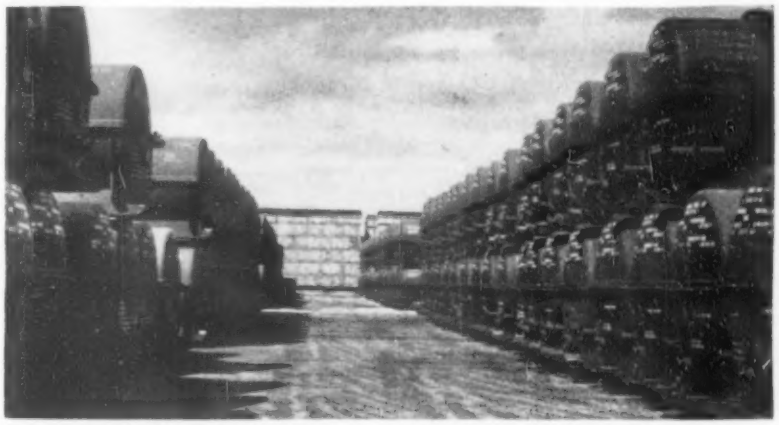
Repair administration is one of the two most important functions of the GFAE project because assembly-line support equipment is bought on the basis of one part for one aircraft, with no leeway for rejections or losses.

And AMC wants the equipment on hand 90 days before it is scheduled for installation.

## Depot Operation

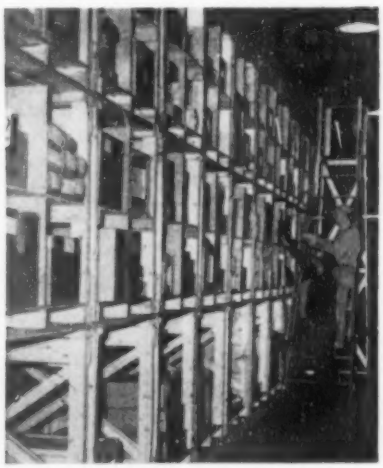
At Topeka AFD, one of the top hardware stores in Air Materiel's chain, the Air Force-Civil Service teams do business within sight of some of the aircraft they support: RB-47s take off across the road at SAC's Forbes base.

Stored in Topeka's 15 huge warehouses are assets totaling approximately $179 million. More than 200,000 of the AFD's prime commodities—aircraft and commercial hardware, special tools,



**ENGINE STORAGE LOT** at Topeka shows canned engines ready for combat units.

**TOWVEYOR** transports various items between storage warehouses at Topeka.



**DEPOT STORAGE,** using this box-pallet method, gives best use of space.

raw materials, chemicals and paints—are processed at this installation each month.

As one storekeeper observed: "I'll bet even Sears Roebuck or Montgomery Ward doesn't handle that much."

▶ **AFD Crystal Ball**—Center of the depot's operation is the Materiel Control Division, where workers forecast the number of initial spares handled by Topeka that a new aircraft will need for a period of 17½ months after the first operational model comes off the assembly line.

There is no magic in this crystal ball. Forecasts are calculated from cold, hard figures on consumption of the prototype plus recommendations from the aircraft's builder. These are given a mathematical working over with a formula devised by Dayton personnel. This is called "provisioning"—one of AMC's hardest jobs.

From the aircraft's performance during the initial support period, Materiel Control computes the number of follow-on spares required for the plane's USAF life.

Topeka calls for bids on these items, then lets contracts.

"This division does the spade and shovel work," says Kenneth Britt, deputy for management and procedures. "Here they control Topeka's stock world-wide, including needs of the Mutual Defense Assistance Program."

▶ **Primary Mission**—After contracts have been let and hardware begins flowing from the vendor into Topeka's bins, storekeepers turn to their primary mission: logistics support of Air Force units.

Topeka's Col. Papik emphasizes speed in handling each requisition from a USAF base.

On priority requests, storekeepers have 12 hours from the time a requisition is filed by teletype or telephone to fill the order and get it out the depot's gate on the fastest transportation available. On routine requisitions received in the mail, they are allowed a maximum of five days.

▶ **Step by Step**—Filling these orders is a step-by-step process set up for fast but careful handling.

A routine order from Edwards AFB for 25 clamp cable assemblies is sent from the mail and distribution department to the depot's editing unit, where it is given a preliminary check and assigned priority. From there the requisition goes to the voucher unit and assigned an AFD control number.

Materiel Control screens the order for availability and, if 25 clamp cable assemblies are in Topeka's bins, codes the requisition for shipment. Logistical Service posts the order, subtracting the assemblies from the depot's inventory lists. The reproduction room then makes up the number of order copies needed for shipping.

In the warehouse, the order is packed and sent to transportation, where shipments are consolidated into carloads to cut costs.

Watchdog over this operation is Materiel Control's inventory section, making sure the prime commodities listed on Topeka's records agree with the number stored in the warehouses.

▶ **AFD Country Store**—For its own supplies, Topeka recently set up a "country store" of housekeeping materials purchased from merchants in the area. The local purchase project, similar to those now operated at most AMC installations, is run like the general store of a small town.

Depot departments "buy" their supplies on a dollar basis, cutting operations costs through elimination of paper work and reduction of man-hours.

Despite the economy of this operation, Topeka officials say they never will turn to local purchase for technical items, such as even the smallest bolt needed in USAF's aircraft program.

"A little 10- or 15-cent item could be as important as a wing," says Britt. "A nut or bolt with lead time on it could ground an entire type of aircraft. As long as it's in our bins, we've got it when we need it."

**Some Depot Responsibilities**

- **Gentile AFD, Dayton**—Airborne radio and radar equipment and maintenance parts; laboratory and shop test inspection equipment and parts.
- **Topeka AFD, Kan.**—Aircraft and commercial hardware; specialized tools and equipment for airframes, engines, propellers and armament and communications systems; metals and composition materials; chemicals and paints.
- **Wilkins AFD, Shelby, Ohio**—Airbase and hangar equipment and special maintenance parts; rubber casings, tires and inner tubes; military uniforms and special purpose clothing; AF publications and technical orders.
- **Mallory AFD, Memphis**—Pre-assembled tool kits; non-powered hand tools, anti-friction bearings and parts; office supplies, equipment and parts; building materials.
- **Rome AFD, N. Y.**—Ground navigation radio systems and parts; ground radio and radar equipment plus instruction units and parts; runway lighting; commercial electrical supplies; meteorological equipment supplies and parts; telegraph, teletypewriter and ground radio communications equipment and parts.
- **Gadsden AFD, Ala.**—Packaging material; refrigeration, heating and plumbing equipment; furniture and fixtures.

▶ **Waste Funnel**—When hardware in Topeka's bins no longer is in demand by USAF, the depot funnels it out of the warehouses to civilian markets through the AFD's disposal department. These include obsolete equipment, parts that are cheaper to replace than repair, and overstocked materials.

On overstocking, storekeepers say they are forced to take a calculated risk on Air Force needs for some items. They lose a few of these bets on future AF demands.

More than 50% of the unusable stocks are given to federal and state institutions or to organizations such as the Boy Scouts; the rest are sent to Topeka's salvage yard and sold for scrap.

One storekeeper says of the operation: "This is one of those places where you're damned if you do and damned if you don't. If we sell them below cost or give them away, we're wasting taxpayers' money. If we keep them in the warehouses, it ups the cost of the depot's operation because warehouse space and caretakers cost money."

Supply's deputy director Poythress confirms this need to get rid of unusable equipment to keep the depot running on a dollars-and-cents basis.

"Taking care of the material costs 25% of its value each year it remains in our bins," he says.

▶ **Economy Projects**—This business-like approach also is apparent in other Topeka operations.

The depot's workload shot up after war broke out in Korea, continued its sharp climb after 1950 and nearly doubled during the last quarter of fiscal 1954. But the personnel needed to do the job is dropping.

The ability to do more with less is worked out by Lt. Col. Papik at daily conferences with his department chiefs. If these meetings fail to come up with a satisfactory answer, a report is sent to AMC's Dayton headquarters and every depot in the hardware store chain works on the problem until it is solved.

Two sample projects that came out of Papik's daily management meetings:

- **Engineering management** study cut 378 persons from the AFD's payrolls in one year, chopping the workforce for the most part by not replacing employes who quit or retired. Few were fired.

"And we did this in the face of decentralization, which increased our responsibility," the colonel says.

- **Conveyor belts** linking the 15 warehouses were built at a cost of $200,000. It saved approximately $235,000 in operating expenses during the first eight months of operation.

"So we made $35,000 in less than a year," the Topeka commander reports. "It's saving us about $30,000 a month now. ■ ■ ■

**CONTRACTOR CHECKS** AMC invitation-to-bid lists posted in Area B, Procurement Division Hq. at Wright-Patterson AFB.



# AMC: Multi-Billion Buying Operation

Air Materiel Command has responsibility for procurement of all equipment and supplies required by USAF. It retains at AMC headquarters authority for buying all aerial weapons systems, supporting systems, sub-systems, government-furnished aircraft equipment and other highly technical items. AMC has also delegated specific portions of its procurement authority to:

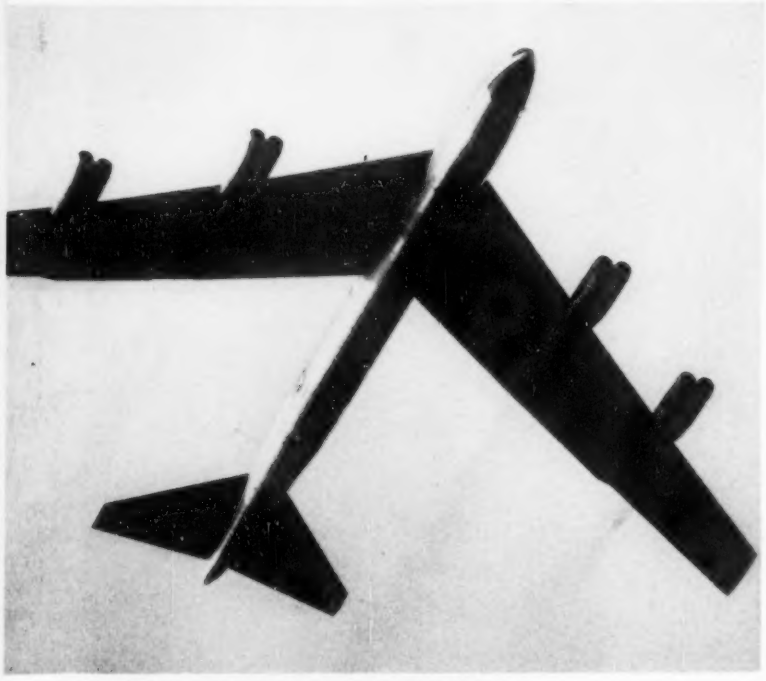
- Air Materiel Areas and depots for specific commodities listed under decentralized procurement.
- Air Research and Development Command for basic research, armament and electronics development and general aircraft design studies.
- USAF bases for standard commercial type housekeeping items.

By next June, more than $23 billion will have flowed through AMC procurement channels for USAF aircraft and related equipment since the outbreak of the Korean war. Today AMC has contracts on its books calling for delivery of $17 billion worth of USAF equipment in the next year and one-half.

Decentralized procurement operations have eased the strain on AMC's most important procurement job of buying billions of dollars worth of new aerial weapons systems. The task of weapons systems buying has grown tremendously due to increasingly complicated technology and the increased scope and complexity of production programs.

To do this new job faster and more efficiently AMC, working with technical assistance of ARDC, has evolved new patterns for conducting its business with the aircraft industry and the Air Force commands that are the ultimate users of the new weapons systems. These changes are detailed in the following pages.

## *Typical Weapons Systems*



BOEING B-52 STRATEGIC BOMBER

MARTIN MATADOR MISSILE

# Industry-AMC Partnership Tackles

By Claude Witze

**The American aircraft industry today carries the greatest responsibility ever vested in private enterprise.**

**It is a full partner of the United States Air Force in a program to supply combat units with the tools of war, moved from development to operation with maximum speed and economy.**

USAF needs far more than the mere airplane with simple gadgets flown in World War II.

Today it buys a weapons system, defined as "an air vehicle together with all the related equipment, both airborne and ground based, the skills necessary to operate the equipment and the supporting facilities and services required to enable the instrument of combat to be a single unit of striking power in its operational environment."

## USAF-Industry Team

With this definition, USAF draws together the team on which America relies for air defense and striking power. On that team are:

• **The Air Materiel Command,** which buys, maintains and supports weapons systems.

• **The Air Research and Development Command,** responsible for technical supervision of weapons systems from the design study to the combat sortie.

• **The operational command,** such as Strategic, Tactical or Air Defense, that uses the weapons system.

• **The aircraft industry,** or weapons system contractor, who develops and produces the weapon, piloted or pilotless.

There never has been a time in history when a nation put so much reliance on non-government agencies. The reliance has increased in direct proportion to the growing complexity of modern aircraft, the same complexity that has turned an airplane into a weapons system. This complexity requires specialists, all the way from basic research to the operation of a bomber or the launching of a missile.

▶ **Weapons System Challenge**—With the weapons system concept, USAF has challenged the aircraft industry to provide all of the intricate devices needed to perform an air mission, making sure they are integrated so that nothing is missing or out of order at takeoff time. The challenge is stated in USAF Reg. 70-9.

"Owing to the increased technical complexity of present day aircraft and equipment; the increasing necessity of obtaining compatibility and integration of the various equipments within a weapons system; and the ever present necessity for expeditious, orderly and economic conversion from the development phase to the production phase, the normal practice for the Air Force will be to accomplish weapons system development through weapons system contractors."

The weapons system comprises such items as propulsion, navigation, fire control, bombing, radio communication, photography and armament systems.

## Industry's Role

A weapons system contractor is needed to integrate all these things because USAF knows the job is beyond the capabilities of its own personnel.

"We simply didn't have enough systems engineers in the Air Force," says one AMC officer.

Closely related to the complexity of a weapons system is another major USAF headache: the need for economy or "more Air Force per dollar." Here

DOUGLAS RB-66 TACTICAL RECONNAISSANCE

CONVAIR F-102 ALL-WEATHER INTERCEPTOR

■ PROCUREMENT

# Aerial Weapons Systems Complexity

is a sound reason for enlisting industry's help while a weapons system is approaching the design stage. It will bring more efficient use of the brainpower and facilities owned by industry.

Maj. Gen. David H. Baker, AMC's director of procurement and production, points out that the old ring and bead gunsight cost only a few dollars. But the APQ-43 radar system used in today's fighters is worth $80,000.

And the Norden bombsight had a price tag of $5,000 against something in the neighborhood of $200,000 for a modern electronic bombing system.

The powerplants for the F-89 all-weather fighter cost more than a complete P-47 Thunderbolt used in World War II.

▶ **Time Cost Is Higher**—In addition to more money, these items now cost more time, which is important to the Air Force.

In 1943 we could build an entire bomber in about the same number of hours required for a B-52 electronic system. In addition to production, the same kind of ratios hold true for the development work done on the electronic machinery in a modern weapons system.

When these figures are put on AMC's timetable for an upcoming project, it becomes clear that the time phasing of components is a major problem. While the subsystems are being developed to go in the B-52, it is possible for ARDC to supervise the development of at least three airframes or vehicles to carry the subsystems.

Working-level officers of AMC carry in their minds a clear concept of their mission. It is to give America the best possible air power at the most appropriate time and at a fair and reasonable cost.

The mission is carried out through the Directorate of Procurement and Production. The duties of this staff, headed by Gen. Baker, are:

- **To procure materiel for USAF.**
- **To determine industrial capabilities.**
- **To insure that USAF industrial mobilization** requirements can be fulfilled.
- **To maintain cognizance** of and to provide a program to expedite production on USAF contracts.
- **To exercise surveillance** over all USAF procurement activity.

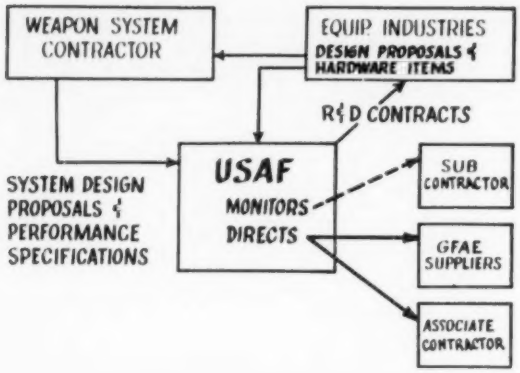
## ARDC's Role

Prime responsibility over the weapons system during the design and development stages is vested in ARDC, which starts the history of a new unit with an exploration of what its officers call "the state of the art." At this point, ARDC, with headquarters in Baltimore, holds procurement authority redelegated to it by AMC.

Actually, this is where the USAF struggle for time phasing begins. Starting with a general operational requirement (GOR) from a using command in USAF, ARDC may ask up to a dozen contractors having experience in the field to consider participating in a design study. If chosen, the firms will be paid for their work, plus a reasonable profit. The cost-plus-fixed-fee type of contract is used primarily because there is no way of predicting what the expenses will be.

Another advantage to the process is that ARDC, in co-ordination with AMC, by carefully placing the invitations, has an opportunity to spread the workload and encourage competent aircraft companies to keep their engineering teams on the job.

▶ **Design Study**—Out of a dozen invitations, possibly eight companies will say they want to participate in the design study. At this point they know what kind of a weapons system is needed, the mission to be performed, the targets to be hit, the kind of




## EQUIPMENT INDUSTRIES RELATIONSHIP TO USAF AND WEAPONS SYSTEM CONTRACTORS PRIOR TO CONTRACT:

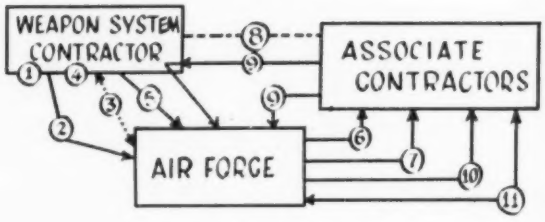
Design proposals and subsystems are evaluated by USAF for:

A. Excellence of technical approach.
B. Determination of items to be Government Furnished Aircraft Equipment.
C. Development required.
D. Where development should be accomplished.

## AFTER CONTRACT:

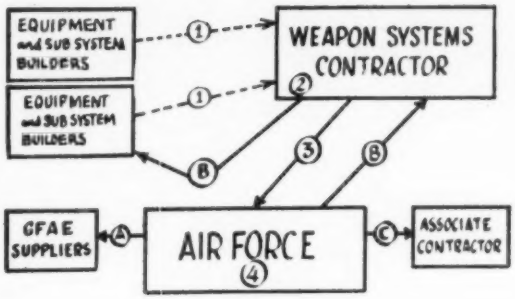
USAF monitors contractors to assure:

A. Optimum use of proven or standard components.
B. Optimum exploitation of "state of the art."




## PROCEDURE FOR ITEMS SECURED BY ASSOCIATE CONTRACT METHOD

1. Weapons system contractor prepares a proposed performance specification for the equipment or subsystem.
2. Weapons system contractor furnishes it to U. S. Air Force.
3. USAF arrives at a mutually agreeable specification with weapons system contractor.
4. Weapons system contractor prepares final performance specification.
5. Weapons system contractor furnishes it to USAF.
6. USAF solicits and evaluates bids, selects associate contractor.
7. USAF negotiates contract with associate contractor.
8. Close liaison established between weapons system contractor and associate contractor.
9. Engineering change proposals are furnished to USAF and weapons system contractor simultaneously.
10. Government authorizes all changes to specifications made by associate contractor.
11. Production specifications are prepared by associate contractor and approved by USAF.

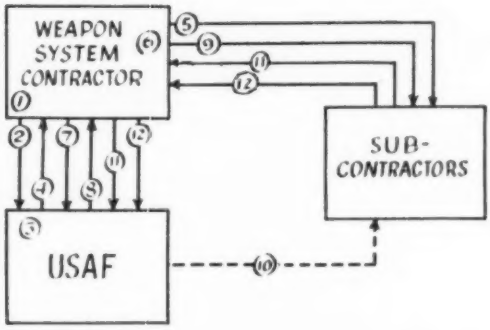



## SELECTION OF CONTRACTUAL METHODS

1. Weapon systems contractor previously will have secured generalized proposals for portions of weapons system from industry.

2-3. Weapons system contractor prepares general design proposal for complete optimized weapons system and furnishes it to USAF.

4. USAF examines proposal for technical adequacy and excellence of approach.
   A. Determines items to be Government Furnished Aircraft Equipment.
   B. Determines items to be secured by subcontract.
   C. Determines items to be secured by associate contractor method.




## PROCEDURE FOR MAJOR NEW ITEMS SECURED BY SUBCONTRACT TO WEAPONS SYSTEM CONTRACTOR

1-2. Weapons system contractor prepares a performance specification for the equipment or subsystem and furnishes it to USAF.

3-4. USAF approves the performance specification and returns it to the weapons system contractor.

5. Weapons system contractor secures design proposals from potential subcontractors.

6-7. Weapons system contractor selects best proposal and sources and furnishes proposal and recommended source to USAF.

8. USAF examines recommended proposal and source together with other approaches and possible sources and approves proposal and source.

9. Weapons system contractor negotiates subcontract.

10. USAF monitors subcontractors' work.

11. Changes which affect form, fit, function or time will be approved by USAF.

12. Final production specifications prepared by subcontractor and approved by weapons system contractor and USAF.

enemy opposition that can be expected.

Their reply must include a technical approach to the problem with complete cost information and other pertinent data. ARDC says its choice of who will be allowed to design a weapons system is based on "scientific merit of the technical proposal, the bidder's experience in this particular field, and the elements of cost involved."

Of eight concerns eager to help in the design study, ARDC may award contracts to four. When the studies come in, the proprietary rights to new inventions still belong to the contractor and he is encouraged to patent them. But USAF retains full license rights and is free to incorporate any of the features into specifications for the weapons system. It is equally free to pass the license rights on to the chosen weapons system contractor, even if it is not the same company that originated the idea as part of a design study.

▶ **Development Plan**—Out of the design study, ARDC and its laboratories draw up a development plan for the weapons system, which is sent to USAF headquarters and reviewed by the Air Council, composed of the chiefs of staff. When it comes back to ARDC with a favorable decision, work is started in cooperation with AMC to draw up a development contract.

Here is where the weapons system contractor enters the picture.

Under the supervision of ARDC and AMC he is made responsible for the engineering studies, design and development needed to integrate the airframe and major subsystems, component equipment, support equipment and other items into a workable weapons system.

USAF is buying both management and technical skill in a wide number of fields.

"To be an expert on a modern airplane," says one AMC officer, "a man would need to be an aircraft designer, an aerodynamicist, a metallurgist, a combustion engineer, an ordnance expert, an electronics wizard, a photo bug and a few more things besides.

"It adds up to about what the best of us could do in five or six lifetimes."

▶ **Management Skill Needed**—AMC emphasizes that the management skills are important. In requesting aircraft companies to bid on a development contract USAF is not going to be satisfied with engineering and production capabilities.

It also demands information not just on basic design and cost, but on how the company plans to solve the problems of maintenance and support essential to the using command.

USAF today has a jet engine that is difficult to inspect in the field. For all practical purposes, it must be pulled out of the airframe and sent to an overhaul depot before a mechanic can look at it.

The introduction of milled skins, demanded in high-speed fighters to provide necessary strength and aerodynamic smoothness, has added greatly to the accessibility problem. In the interest of structural integrity and the flow of air over a wing at sonic and supersonic speeds, the myriad of inspection holes and covering plates common to slower planes has disappeared.

The manufacturer's ability to come up with the right answers to these problems is considered and evaluated along with the more obvious factors, such as cost and the ability to roll completed weapons systems out of the factory door.

▶ **Service Test Procurement**—Once a contractor is selected, he immediately starts to demonstrate his management and technical skill in development of the weapons system to USAF's specification. This is followed by an initial procurement contract for a limited number of weapons systems—from a dozen to 50—to provide USAF with articles for an intense service test.

The service test quantity goes through the paces uncovering "bugs" while inventory production is kept low. This is the so-called Cook-Craigie plan, designed to insure that major modifications will be made before real production starts.

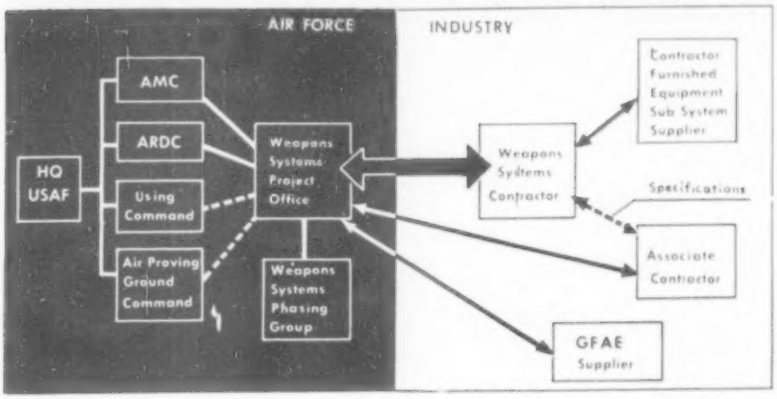
The actual number of weapons systems ordered at this period varies according to the lead-time factor and the manufacturer's production setup, including other work under way in his plant.

"We want to hold orders down to the amount necessary to permit reorder," is the way AMC puts it. "In effect, we ask the contractor to tell us how big an order he must have to maintain producibility until we get more funds and want to start buying for inventory.

"Our purchases are based on the need to buy."

Practical effect of this policy is to hold output down to a few items per month through the first year.

WEAPONS SYSTEMS MANAGEMENT PARTNERSHIP




## Subcontractor's Role

While the weapons system contractor is given management responsibility for successful integration of all the subsystem, component and support equipment, the weapons system concept leans heavily on subcontractors. The regulations provide for four sources of subcontracted parts, sub-systems and components.

- Some sub-system components will be developed by and procured directly from the weapons system contractor and his subcontractors.

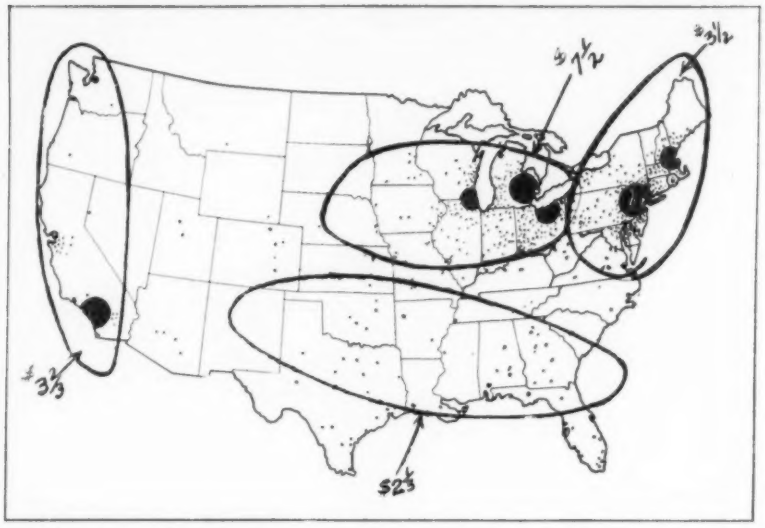
This is called contractor furnished equipment (CFE). In addition to the airframe itself, it includes landing gear, hydraulic actuators, pumps and valves, integral fire extinguishers, oxygen equipment, external fuel tanks, radomes, minor electrical equipment, electrical starters, flight control systems (in missiles), some electronic countermeasure and mooring kits.

- Some subsystems will be developed by associate contractors, who will be USAF prime contractors working to meet a specification prepared by the weapons system contractor.

Items that will be bought from associate contractors include major electrical power supply equipment, non-electrical starters, missile propulsion systems, JATO units, constant speed drives, airborne and ground guidance systems for missiles, flight control, bombing, navigational, fire control and camera control systems and flight simulators.

- A third category of components will be furnished to the weapons system contractor as government furnished aircraft equipment (GFAE). These items

## Distribution of AMC contract backlog




**MAP** shows geographical distribution of AMC contractors and the regional dollar volume of order backlogs scheduled for delivery to USAF during the next 18-20 months.

are built to USAF specifications and bought directly by USAF. They include wheels, brakes, tires, tubes, engines (not for missiles), instruments, radio and radar, inflight refueling equipment, safety belts, ordnance equipment and special weapons equipment.

• A final category, also GFAE, will be purchased directly by USAF to its own specifications and issued to USAF bases. The weapons system contractor never will see these items at his plant, but he must be sure nothing interferes with their utility when combat and maintenance crews want to use them.

Included are such items as headsets and microphones, bomb hoists, cargo tie-down equipment, litters, flare signals, life rafts, survival kits, portable oxygen equipment, portable radio equipment, GCA units, ILS units, crash trucks, common tools, test equipment and personal equipment.

## Associate Contractor

Among these categories, veterans immediately will spot the associate contractor as a new camel in the tent, admitted last November with the promulgation of Air Force Regulation 70-9. He is there for a number of reasons:

• As an expert in his field with his own staff of engineering talent and production facilities, AMC can use him to help solve the economy and time phasing problems growing out of development and production of the items listed in this category.

• While he gets his specifications from the weapons system contractor, the associate contractor sells to AMC and operates under the technical supervision of ARDC. This gives USAF, in approving the source, a chance to consider such things as ability to produce, location, vulnerability to enemy attack, labor supply and other factors.

• The weapons system contractor in many cases is dwarfed by the size of the associate contractor and would be at a disadvantage in financial and business relations without USAF as an intermediary.

• There are situations in which the subsystem or component manufacturer must enlarge his market beyond the possibilities of a single weapons system. Unless he can place the item in several aircraft, his development and tooling costs will not be economically feasible to AMC and the American taxpayer.

• Because the weapons system contractor drafts the specifications, and has his preferences considered by AMC and ARDC in the choice of the subcontractor, USAF expects their relationship will be smoother than that which exists in some cases between a prime contractor and a GFAE supplier.

• USAF's control over current procurement and facilities available in case of wartime mobilization are improved by having AMC buy direct from the associate contractor. No weapons system contractor, buying company-furnished equipment, can consider the long-range requirement for all of the Air Force or, in some cases, even for his own system.

One of the weaknesses revealed in the Korean buildup was the discovery that some prime contractors would order only the initial quantity of a component and the subcontractor was at a disadvantage in calculating follow-on possibilities.

• There are cases where USAF will benefit by creating secondary sources of subcontracted systems or components. It can do this under the associate contractor system.

• For AMC, buying from an associate contractor is more economical than purchase of CFE items. The obvious reason is that from the viewpoint of Dayton's buyers, the weapons system contractor is a middleman.

• Introduction of the associate contractor last fall was hailed as a victory for the component manufacturers in their fight against the badly misunderstood "single prime contractor" concept pushed at one time by ARDC and approved by AMC.

▶ **No Blank Check**—Brig. Gen. M. C. Demler, vice-commander of Wright Air Development Center, has explained the misconceptions regarding ARDC policy.

"Many contractors," he says, "understand that USAF was giving the weapons system contractor a blank check under which he would proceed to develop—on his own, in his own facilities or facilities which he would create or control—all components, equipments and subsystems required for the weapons system.

"Nothing could be further from the true intent."

Actually, the "true intent" may not be clear if the casual observer tries to find examples of the weapons system concept in operation. There are two good reasons for this. First is that the regulations permit AMC and ARDC to deviate from procurement procedure if they agree there are good reasons for doing so. The reasons could involve such factors as technical aspects of the problem, time schedules, the status of USAF developments and the capability of contractors under consideration.

The current weapons system procurement regulation, AFR 70-9, is about nine months old, but there is no weapons system today being purchased entirely under its terms and policies. In the case of the F-105 or B-66 there are many CFE items that would be supplied by associate contractors if 70-9 were not so recent an innovation. The B-58 is specifically exempt from its provisions.

Guided missiles, by their very nature, must contain a large share of CFE because of the technical integration problems that must be solved.

AMC officers say the weapons system policy, and AFR 70-9, will be applied to all possible purchasing in fiscal year 1955. And they are trying to move items from CFE to the associate contractor method on current orders wherever it can be done without serious interference with efficiency.

▶ **Tests for AFR 70-9**—There are four development competitions now under

way that will come entirely under the terms of 70-9 and give the regulation its first real implementation. The competitions involve a jet tanker, a utility helicopter, a long-range interceptor and a fighter-bomber.

The first equipment contract placed with an associate contractor was awarded recently to the Eclipse-Pioneer Division of Bendix Aviation Corp., for the design, development and production of a PB-20 autopilot system for the YC-133 turboprop transport. In this case, the associate contractor is working directly with Douglas Aircraft Corp., which provided the specifications. When the autopilot is in production, it will be bought by USAF and given to Douglas for inclusion in the aircraft.

## Project Offices

Shouldered with full responsibility for integration and production of the weapons system, the contractor cannot be expected to have the time, manpower and patience to contend with the old USAF merry-go-round where his representative could interview scores of officers and not get an answer to a question.

To provide a focal point for his relations with USAF, in 1949 ARDC and AMC created joint project offices for weapons systems. The JPO was a place where the contractor and every interested party in USAF, from the using command to headquarters, could keep abreast of development and production.

Last October the idea was formalized and the name changed to Weapons Systems Project Offices (WSPO) with the promulgation of AFR 20-10.

WSPO is the place where critical decisions are made, balancing economic feasibility with technical excellence. For

**PAPERWORK** growth shown between original Wright contract and AMC B-47 pact.

example, a proposal was made that the design of a bomber wing be changed to simplify construction and save 40 pounds of weight. The idea had merit; a cheaper and better wing could be built to the altered specification. However, a study revealed that the change would be made so late in the production program that the cost of new tooling would be more than the total economy possible in the remaining number of bombers. The proposal was rejected.

The regulation creating WSPO says its mission is "to manage the program" and "achieve proper phasing of actions pertaining to development, procurement, production, maintenance, and supply in order that the weapon system can be delivered and supported in a timely manner."

► **Delineates Roles**—It further delineates the roles of ARDC and AMC by requiring that "executive management responsibility" be clearly established at all times. ARDC is the executive agent during the development of a new weapons system, serving in this capacity at the start of a new project. Responsibility shifts to AMC when the weapons system goes into the production phase. USAF headquarters will issue a directive fixing the exact time of the shift in executive responsibility.

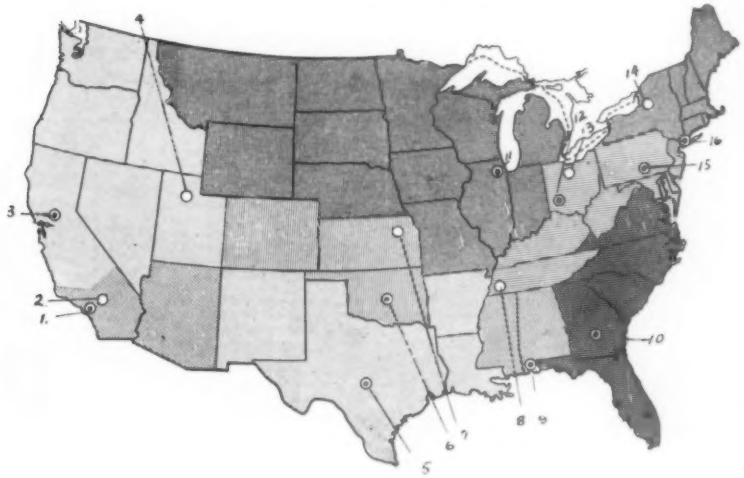
Importance of this to the aircraft industry is that WSPO always has a boss, to whom the weapons system contractor can direct his queries.

Regardless of the point in the life span of a weapons system and regardless of which command has executive responsibility, the duties of WSPO remain clearly defined:

- **It must schedule,** initiate and administer programs for the development, testing and production of a weapons system and its components.
- **It must call on any USAF command** with a vested interest in the weapon to provide necessary specialists when studies or recommendations are needed.
- **It must keep close contact with industry** and serve as the single contact point for a weapons system contractor in his dealings with USAF on development and production.
- **It must keep top echelons fully posted** on matters that may interfere with USAF's objectives. This covers items affecting the weapons system's utility in combat, delivery schedules, logistic support, tactical capabilities and the USAF-industry relationship.

The weapons system contractor is concerned chiefly with the third of these WSPO duties. The aircraft or component manufacturer will go to this office when he wants to do business in these fields:

## Where AMC Contractors Are Paid

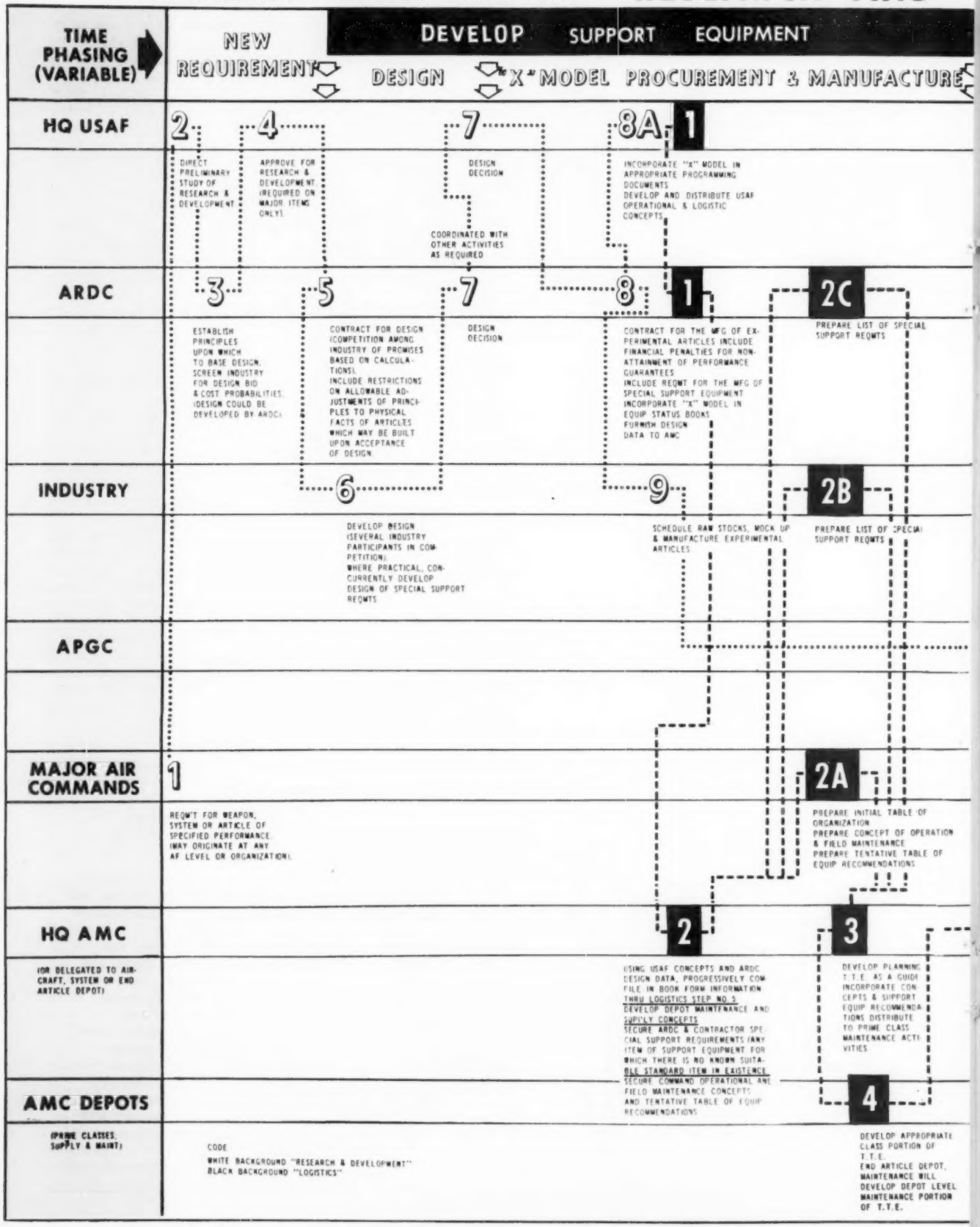


**AMC FINANCE OFFICES**
(Shaded areas indicate paying jurisdidction)

1. *AMC Finance Office, Los Angeles
2. San Bernardino AMA, Norton AFB
3. *Sacramento AMA, McClellan AFB
4. Ogden AMA, Hill AFB
5. *San Antonio AMA, Kelly AFB
6. *Oklahoma City AMA, Tinker AFB
7. Topeka AFD, Topeka, Kan.
8. Mallory AFD, Memphis, Tenn.
9. Mobile AMA, Brookley AFB
10. *Warner Robins AMA, Robins AFB
11. *AMC Finance Office, Chicago
12. *AMC Finance Office, Dayton
13. Wilkins AFD, Shelby, Ohio
14. Rome AFB, Griffis AFB
15. *Middletown AMA, Olmstead AFB
16. *AMC Finance Office, New York, N. Y.

* Indicates offices paying central procurement contracts.

# MANAGEMENT CONTROL GUIDE FOR RESEARCH AND DEVELOP SUPPORT EQUIPMENT


TIME PHASING (VARIABLE)
NEW REQUIREMENT
DESIGN
"X" MODEL
PROCUREMENT & MANUFACTURE
HQ USAF
2
DIRECT PRELIMINARY STUDY OF RESEARCH & DEVELOPMENT
4
APPROVE FOR RESEARCH & DEVELOPMENT (REQUIRED ON MAJOR ITEMS ONLY).
7
DESIGN DECISION
COORDINATED WITH OTHER ACTIVITIES AS REQUIRED
8A
1
INCORPORATE "X" MODEL IN APPROPRIATE PROGRAMMING DOCUMENTS
DEVELOP AND DISTRIBUTE USAF OPERATIONAL & LOGISTIC CONCEPTS
ARDC
3
ESTABLISH PRINCIPLES UPON WHICH TO BASE DESIGN, SCREEN INDUSTRY FOR DESIGN BID & COST PROBABILITIES. (DESIGN COULD BE DEVELOPED BY ARDC)
5
CONTRACT FOR DESIGN (COMPETITION AMONG INDUSTRY OF PROMISES BASED ON CALCULATIONS). INCLUDE RESTRICTIONS ON ALLOWABLE ADJUSTMENTS OF PRINCIPLES TO PHYSICAL FACTS OF ARTICLES WHICH MAY BE BUILT UPON ACCEPTANCE OF DESIGN.
7
DESIGN DECISION
8
1
CONTRACT FOR THE MFG OF EXPERIMENTAL ARTICLES INCLUDE FINANCIAL PENALTIES FOR NON-ATTAINMENT OF PERFORMANCE GUARANTEES
INCLUDE REQMT FOR THE MFG OF SPECIAL SUPPORT EQUIPMENT
INCORPORATE "X" MODEL IN EQUIP STATUS BOOKS
FURNISH DESIGN DATA TO AMC
2C
PREPARE LIST OF SPECIAL SUPPORT REQMTS
INDUSTRY
6
DEVELOP DESIGN (SEVERAL INDUSTRY PARTICIPANTS IN COMPETITION). WHERE PRACTICAL, CONCURRENTLY DEVELOP DESIGN OF SPECIAL SUPPORT REQMTS
9
SCHEDULE RAW STOCKS, MOCK UP & MANUFACTURE EXPERIMENTAL ARTICLES
2B
PREPARE LIST OF SPECIAL SUPPORT REQMTS
APGC
MAJOR AIR COMMANDS
1
REQMT FOR WEAPON, SYSTEM OR ARTICLE OF SPECIFIED PERFORMANCE. (MAY ORIGINATE AT ANY AF LEVEL OR ORGANIZATION).
2A
PREPARE INITIAL TABLE OF ORGANIZATION
PREPARE CONCEPT OF OPERATION & FIELD MAINTENANCE
PREPARE TENTATIVE TABLE OF EQUIP RECOMMENDATIONS
HQ AMC
2
USING USAF CONCEPTS AND ARDC DESIGN DATA, PROGRESSIVELY COMPILE IN BOOK FORM INFORMATION THRU LOGISTICS STEP NO. 5
DEVELOP DEPOT MAINTENANCE AND SUPPLY CONCEPTS
SECURE ARDC & CONTRACTOR SPECIAL SUPPORT REQUIREMENTS (ANY ITEM OF SUPPORT EQUIPMENT FOR WHICH THERE IS NO KNOWN SUITABLE STANDARD ITEM IN EXISTENCE
SECURE COMMAND OPERATIONAL AND FIELD MAINTENANCE CONCEPTS AND TENTATIVE TABLE OF EQUIP RECOMMENDATIONS
3
DEVELOP PLANNING T.T.E. AS A GUIDE INCORPORATE CONCEPTS & SUPPORT EQUIP RECOMMENDATIONS DISTRIBUTE TO PRIME CLASS MAINTENANCE ACTIVITIES
(OR DELEGATED TO AIRCRAFT, SYSTEM OR END ARTICLE DEPOT)
AMC DEPOTS
4
DEVELOP APPROPRIATE CLASS PORTION OF T.T.E.
END ARTICLE DEPOT, MAINTENANCE WILL DEVELOP DEPOT LEVEL MAINTENANCE PORTION OF T.T.E.
(PRIME CLASSES, SUPPLY & MAINT)
CODE
WHITE BACKGROUND "RESEARCH & DEVELOPMENT"
BLACK BACKGROUND "LOGISTICS"

# DEVELOPMENT AND LOGISTICS

REQMTS → BUDGETING → FUNDING → PROCUREMENT → PRODUCTION OPERATIONS

TESTING ↔ SELECTION

(Weapons and Support Equipment)

**12** APPROVE, MODIFY OR DISAPPROVE FOR AIR FORCE USE.

**6** INCORPORATE WEAPON SYSTEM OR ARTICLE IN BUDGET PROGRAM GUIDANCE
APPROVE OR REFINE ALL CONCEPTS UPON WHICH T.T.E. IS BASED

**8** PUBLISH & FUND APPROVED PROGRAM

**11** PREPARE RECOMMENDATIONS AND STATUS CLASSIFICATION
GRANT DESIGN APPROVAL FOR SPECIAL SUPPORT REQMTS

**13** COORDINATED WITH OTHER ACTIVITIES AS REQUIRED

PREPARE PRODUCTION PROCUREMENT SPECIFICATIONS FOR END ARTICLE & SPECIAL SUPPORT REQMTS

**11B** GRANT DESIGN APPROVAL AS REQUIRED FOR PRODUCTION RELEASE DESIGN DISAPPROVAL CAN BE MADE ONLY IF PROCUREMENT SPECIFICATIONS FOR AN ALTERNATE ITEM CAN BE FURNISHED AS REQUIRED FOR PRODUCTION RELEASE

**5A** EVALUATE TOTAL SUPPORT REQMTS

**10** TOOL AND SCHEDULE RAW STOCKS
FINALIZE SUPPORT EQUIPMENT REQUIREMENTS COORDINATING PREVIOUS CONTRACTOR EXPERIENCE, USAF CONCEPTS AND T.T.E.
PREPARE SUPPORT EQUIPMENT RECOMMENDATIONS (DRAWINGS, LISTS, QUANTITIES AND ESTIMATED PRICES)

**12** PRODUCTION RELEASE AND MANUFACTURE OF AIRCRAFT, SYSTEM OR ARTICLE AND SUPPORT EQUIPMENT

**10** TEST EXPERIMENTAL ARTICLES (END ARTICLE AND SPECIAL SUPPORT EQUIP)

**11** PREPARE RECOMMENDATIONS & STATUS CLASSIFICATION

**13** OPERATE WEAPON SYSTEM OR ARTICLE AND SUPPORT EQUIP USING T.T.E. AND OPERATING EXPERIENCE FINALIZE PERMANENT AUTHORIZATION DOCUMENTS

**5** FINALIZE AND PUBLISH T.T.E. INCLUDING CONCEPTS UPON WHICH T.T.E. IS BASED (TO BE REFINED FROM THIS POINT ON)
FURNISH COPY TO CONTRACTOR FOR ANALYSIS OF TOTAL SUPPORT REQMTS.
ARRANGE FOR SHIPT OF AF ITEMS OF SUPPORT EQUIP TO CONTRACTOR AS REQUIRED TO DETERMINE SUITABILITY OF STANDARD ITEMS.

**7** BUDGET FOR WEAPON SYSTEM OR ARTICLE AND UNIT MISSION EQUIPMENT (USING APPROPRIATE PORTION OF T.T.E.)

**9** PROCURE WEAPON SYSTEM OR ARTICLE AND UNIT AND SPECIAL SUPPORT EQUIP.
FURNISH CONTRACTOR WITH CONCEPTS OF OPERATION, MAINTENANCE AND SUPPLY.
FURNISH CONTRACTOR WITH T.T.E. AS A GUIDE IN RECOMMENDING SUPPORT ITEMS CONSIDERING STANDARD ITEMS INCLUDED.

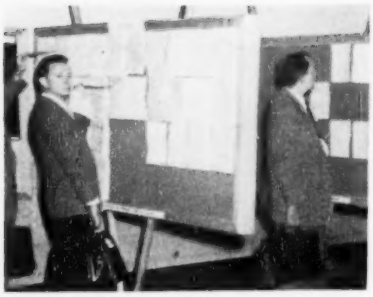
**11** CONTROL AND MONITOR FINAL SELECTION OF SUPPORT EQUIP
USE BUDGETING PRICED T.T.E. AND CONTRACTOR COST ESTIMATES AS A MONETARY CONTROL GUIDE

**7A** BUDGET FOR BASE SUPPORT EQUIPMENT (USING APPROPRIATE PORTION OF T.T.E.)

**9A** PROCURE BASE SUPPORT EQUIPMENT USING APPROPRIATE PORTION OF T.T.E.
(NORMAL PROCUREMENT, NOT CHARTED)

**11A** SELECT ITEMS (MAINTENANCE)
REFER, AS REQUIRED, ANY ITEMS STILL REQUIRING DESIGN APPROVAL TO ARDC
COMPUTE QUANTITIES (SUPPLY)

**14** PROCURE ADDITIONAL REQUIREMENTS AND FOLLOW ON SUPPORT BASED ON UNIT EQUIPMENT ALLOWANCE LIST AND BASE EQUIPMENT ALLOWANCE LIST REPORTING & BUDGETING



**BID CHECKING** is daily ritual at AMC.

• To obtain review and approval of model specifications.

• To submit a statement of work, covering the number of weapons systems to be produced, the delivery schedule, tooling rates and tooling durability.

• To negotiate contract terms and all the related paperwork, including purchase requests. The WSPO at this point determines what type of contract is most advantageous to USAF.

• To obtain contract change notifications and review of engineering change proposals (ECPs). WSPO also can initiate these changes if it believes the weapons system will be improved within reasonable cost limitations.

• To negotiate supplemental agreements that may result from engineering and schedule changes.

• To obtain information on GFAE schedules and changes.

• To provide USAF with information on maintenance, major modifications and retrofits that will be needed in the field.

► **Place for Specialists**—The contractor can be sure that he will talk to USAF specialists when he goes to the WSPO.

From ARDC, he will meet project engineers assigned to monitor the systems, subsystems and components such as engines, bombing, navigation and fire control mechanisms.

From AMC, he will meet experts on production, production engineering and contracts. These groups are ready to set up GFAE schedules, take responsibility for tooling rates and the interchangeability of components. They will co-ordinate deliveries in the face of speedups or stretchouts and send out trouble-shooters when material shortages threaten to upset the assembly line. They will evaluate engineering changes from the standpoint of how much they cost and how much good they will do.

While WSPO's duties include the submission of reports on matters that would interfere with a weapons system's utility, there is no direct connection with the command that will use the aircraft. To overcome this limitation, another organization, called the Weapons System Phasing Group, holds monthly meetings with WSPO.

## Phasing Group

The phasing group includes representatives of maintenance and supply as well as procurement in AMC, ARDC, the Air Training Command, USAF headquarters, the prime depots and the tactical commands. It is a clearing house, where military men are encouraged to lay their cards on the table, voice their gripes and their skepticism.

Brain child of Maj. Gen. Clarence S. Irvine, deputy commander of AMC for production, the phasing group provides one platform where USAF can see the whole weapons system and how it will work or won't work. Meetings result in action, because problems are defined and people are assigned to find solutions.

Gen. Irvine, who serves as a right hand and "trouble-shooter" for AMC's boss, Gen. Edwin W. Rawlings, says the phasing group was started because his "customer"—the using command, such as SAC, TAC or ATRC—was entitled to more consideration.

"When they get together we can spot trouble and potential trouble very quickly," Gen. Irvine says. "This way we can find out that the patient is sick before he is dead."

It is Gen. Irvine's goal to add industry representatives to the weapons phasing group. In this way he hopes to improve the degree of assistance provided by the aircraft industry in solving USAF's support problems.

► **Advice to Contractors**—Here is some of his advice to weapons systems contractors:

"It is important," the general says, "that industry give sufficient emphasis to support items, with early recommendations for what is required. Only in this way can procurements be made for delivery with the weapons system.

"Any end item that reaches the field without support equipment," he warns, "is going to receive a bad name. It is dead weight in a logistics system that can't afford dead weight.

"One of the best sales gimmicks is that of insuring an accurate support equipment list as soon as possible after a contract is signed. Some companies will stand around with the attitude that this is common support equipment and the Air Force can worry about it. The smarter ones pitch in to get the wheels rolling."

Further advice to contractors from Gen. Irvine:

• Make sure technical data and spares arrive at the combat base with the weapons system.

• Make sure support equipment is planned adequately, designed, produced and phased to arrive with the weapon.

• Make sure accessibility and ease of maintenance are emphasized in design and production.

• Make sure you have designed and built your weapons system for all three crews—combat, support and maintenance.

• Help keep USAF's spare inventory as low as possible and speed up the turnaround time between sorties.

The aircraft industry will justify USAF's decision to give it greater responsibility under the weapons system concept only if the combat teams get a maximum number of sorties with minimum investment in men and material.

Among veterans at Wright-Patterson AFB it is axiomatic that the well-worn "more Air Force per dollar" slogan basically goes back to men and material.

"They are our only two real resources," says one civilian who has been on the job for a record 36 years. "Our job is far more than just clever buying. We must make sure that America gets every possible defense benefit out of every pound of metal and man-hour of work. More efficient utilization of these things can be done through the weapons system concept."

## AMC Contracts

Prime tool of AMC in effecting this kind of economy is the contract, of which the command has four authorized forms:

### Fixed Price

• **Straight fixed price.** When feasible to use for supplies or services. There must be an existence of competition, or in the absence thereof, an analysis of whether the price is fair and reasonable must be possible.

• **Form I.** When possible to make accurate cost estimates for the first period but not for the duration of the contract. This form lends itself to the company pricing "approach."

• **Form IIA.** When cost estimates can be made for the performance of the entire contract, but variations may occur because of unpredictable changes in volume, material prices, wage rates or production techniques.

### Retroactive Pricing

• **Form IIB.** When accurate cost estimates cannot be made at the outset, but unit costs can be projected after production experience is obtained.

• **Form III.** When contracts are strictly developmental or experimental in character, and the amount is $100,000 or less. The initial price is expected to bear a reasonable relationship to the expected final price.

• **Form IV.** When contracts are for experimental or developmental items, or services for tests, and in-production

contracts with delivery schedules of short duration. The maximum price is expected to bear a reasonable relationship to the target price.

### Cost Reimbursable

• **Cost.** When likely to be less costly to the government, or if it is impractical to contract on any other basis.

### Cost-Plus-Fixed-Fee Incentive

• **Fixed price.** When items have been produced previously and sufficient production and cost experience is available to assure establishment of a realistic target price, and when there is a reasonable opportunity for contractor to reduce the cost.

• **Cost-plus-incentive-fee.** When accurate cost estimates cannot be made at the outset, but when, with a reasonable production run, incentive can be introduced. Cost-plus-incentive-fee is the same as cost-plus-fixed-fee except that the incentive feature is likely to prove less costly than the cost-plus-fixed-fee.

▶ **Price Redetermination**—These additional features are pointed out by AMC:

• Price redetermination or "reset" is provided in each of these types of contracts except the first, the straight "fixed-price" deal, which holds for the vast majority of hardware of "off-the-shelf" items used by USAF.

• The point in the history of a contract where the price is reset varies according to the type of work being performed. In some cases it is predetermined, in others at an optional point. In the case of Form III, it is done on demand of the contracting officer, if he feels the price should be reduced at the close of the developmental or experimental work.

• In the cases of Form IV and the incentive fixed-price contracts, there is a definite ceiling established at the outset and the final price, after redetermination, cannot exceed that ceiling.

• The "reset" price is based on the contractor's experience and AMC policy is to maintain a healthy industry. There is no effort to force prices down. The aim is to fix a price that is fair and reasonable for both the manufacturer and USAF.

▶ **Other Guideposts**—Unwritten in the regulations, but followed as a guide in all contract negotiations, are a number of factors that influence AMC contracting officers in their approach.

One of them is the manufacturer's attitude and record in the field of research and development. A few AMC officers express concern over the failure of some companies to protect their own future by participating in design-study proposals or taking other steps to discover new products. Development ingenuity, they say, is a factor considered in the determination of profits.

Here are some other elements that are important to USAF in deciding how much money a contractor should be permitted to make:

• **How much of the company's own money** is invested in the plant, how dependent are they on government-furnished facilities and how much federal financing is utilized?

• **What is the backlog** of government orders?

• **How complex is the end item** and how much technical and management know-how goes into the job?

• **What is the company's past performance** record, particularly in regard to deliveries, quality, technical and managerial performance?

• **How much risk** is involved for the company in taking this contract?

Company performance on these questions is the measure of its fitness to assume the responsibility AMC wants it to have, according to Gen. Baker, and AMC will show its confidence in a practical way. One sign of the trend is an increase in the number of fixed-price and incentive fixed-price contracts.

**MANUFACTURERS' REPS** check in at reception desk prior to making their calls.

These rewards are not given to inefficient or marginal producers. A company record studded with examples of high costs, technical troubles, poor management, questionable quality and delivery disappointments will not bring profit prizes.

Gen. Baker lists some other things he is striving to do as the aircraft industry proves itself competent to meet USAF's challenge:

• To reduce auditing. The backlog has been eliminated and AMC's procurement team is striving to use the contractor's information at every possible point.

• To cut the time required for redetermination of prices and to move the time of redetermination up as early as possible in the contract. A recent survey showed that AMC is questioning only about 5% of the subcontract structures and has failed to concur in less than 1% of those reviewed.

• To cut down, eliminate as much as possible, the number of letter contracts, or temporary deals, that delay final negotiations with contractors. In an effort to give the industry firm commitment as early as possible, the number of letter contracts has been reduced to an all-time low, down 80% in the past year.

• To reduce the number of reviews required of contracts between weapons system contractors and their subcontractors for CFE items. The current aim is to let contracting officers approve purchasing systems instead of taking the slow road of detailed examination into CFE purchase terms.

In relations with the aircraft industry, Gen. Baker makes it clear that the Air Force wants to break away from internal details of the industry's management. A certain amount of this was necessary during the Korean buildup, he says, but the aim today is to turn back the fullest degree of control, "gradually yet positively." Says Gen. Baker:

"We can approach this objective in at least two ways. One is to establish policies and procedures that will enable industry to take over the complete responsibility sooner or even at the beginning of a project.

"Another way is to get our fingers out of management's internal business wherever we can do so without jeopardizing our responsibility to the people of the United States and to the future security of our country."

This is AMC's assurance that along with its new responsibility, the aircraft industry can assume at least gradual increase of its authority. Management's performance under the weapons system concept, demonstrating it is competent to hold this authority from AMC and the American people, will protect the future of the country and the democratic world. ■ ■ ■

# TABULATION OF TEAM CAPTAIN RESPONSIBILITIES

## AMC-ARDC Weapons System Project Office Responsibilities

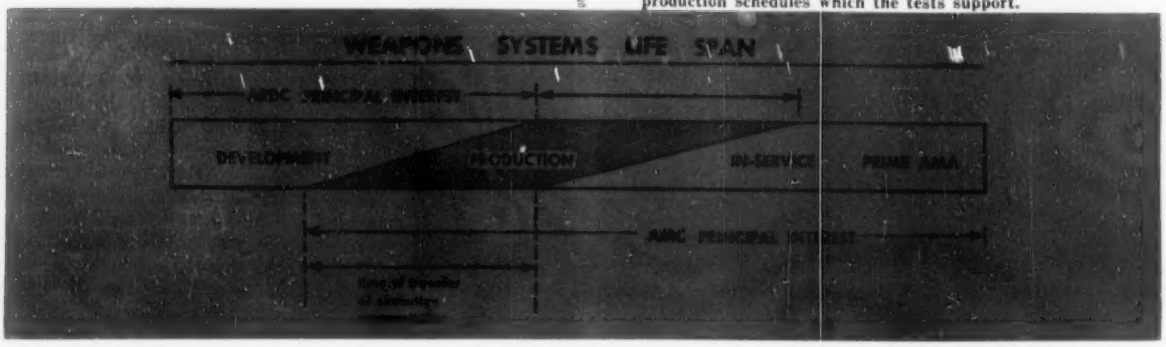
## UNDER ARDC TEAM CAPTAINCY

| AMC | | ARDC |
|---|---|---|
| | **GENERAL** | 1. Primary responsibility—Team Captain. Establish and demonstrate design integrity. |
| | **ENGINEERING** | 2. Establish and control configuration:<br>a. For new articles, by preparing specifications (or review of contract or specification proposals) prior to contractual incorporation.<br>b. For changes, determine and direct (thru AMC contract channels) changes required to insure article will be:<br>(1) Safe to operate.<br>(2) Capable of military mission.<br>(3) Mechanically satisfactory. |
| 1. Furnish required procurement and production support to ARDC. | | |
| 2. a. Insure that ARDC-directed configuration is contractually established.<br>b. Insure that specifications provide for producibility and ease of maintenance, whether basic specs or changes thereto. | | |
| | **SCHEDULES** | 3. a. Establish development schedules coordinating with AMC as to industry and facility support capability.<br>b. Determine jointly with AMC when release for quantity production should be made. |
| 3. a. Coordinate development schedules to insure industry support capability and availability of government furnished facilities.<br>b. Participate in joint determination of production readiness.<br>c. Upon establishing production readiness, prepare recommended production plan. | | |
| | **BUDGETS** | 4. If R&D funds are to be used, prepare and defend budgets. |
| 4. Prepare and defend all non R&D fund requirements for procurement of ARDC-approved configurations to approved schedules. | | |
| | **CONTRACTUAL** | 5. a. Accomplish contracts specifically authorized by the Undersecretary.<br>b. Prepare PRs and work statements if R&D funds are to be used. |
| 5. Perform all procurement and contracting functions except those specifically directed to be redelegated to ARDC by the Undersecretary. | | |
| | **TESTING** | 6. a. Prepare all test schedules in coordination with AMC.<br>b. Accomplish all AF-performed testing with exception of tests specified for APGC.<br>c. Approve and monitor all contractor-performed testing. |
| 6. a. Coordinate with ARDC on test schedules.<br>b. Make contractual arrangements for contractor-performed testing. | | |

## AMC-ARDC Weapons System Project Office Responsibilities

## UNDER AMC TEAM CAPTAINCY

| AMC | | ARDC |
|---|---|---|
| | **GENERAL** | |
| 1. Primary responsibility—Team Captain: | | 1. Furnish required engineering support to AMC. Establish and demonstrate design integrity. |
| | **ENGINEERING** | |
| 2. a. Procure ARDC-recommended configuration insofar as it is production-supportable and coordinate any deviations with ARDC.<br>b. Incorporate, after proper consideration of production effect on schedules and costs, ARDC-approved changes only.<br>c. Incorporate changes required for producibility and ease of maintenance after coordination with ARDC. | | 2. a. Establish and recommend initial optimum production and configuration.<br>b. Establish (or review and approve) change proposals, recommend configuration and priority (thru AMC channels) of changes required to insure article will be:<br>(1) Safe to operate.<br>(2) Capable of performing military mission.<br>(3) Mechanically satisfactory |
| | **SCHEDULES** | |
| 3. Establish and implement all production schedules, including end item and all supporting components and services. | | 3. Give proper cognizance to approved schedules when planning configuration development. |
| | **BUDGETS** | |
| 4. Establish budget plans and administer all approved budgets. | | 4. Give proper cognizance to approved budgets when planning configuration development. |
| | **CONTRACTUAL** | |
| 5. Perform all procurement and contracting functions. | | 5. Insure that all contractual matters are referred through proper AMC channels. |
| | **TESTING** | |
| 6. a. Coordinate with ARDC on test scheduling.<br>b. Make contractual arrangements for contractor-performed testing. | | 6. a. Prepare all test schedules in coordination with AMC.<br>b. Perform testing in ARDC centers or approve and monitor contractor-performed tests giving due regard to production schedules which the tests support. |



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# AMC Planners Phase Weapon Systems

When AMC buys weapons systems it takes the first step toward the fulfillment of USAF's mission.

The mission is assigned, four years before the aircraft industry sits down to negotiate a contract, by the Joint Chiefs of Staff. They tell the Air Force, as well as the Army and Navy, what job must be done.

This delegation of responsibility is based on a Master War Plan, drawn up by the National Security Council and approved by the President as Commander-in-Chief of the Armed Forces.

USAF's present goal to perform its mission is 137 wings. When it is reached, production orders will be eased and the existing wings kept modern, unless the Joint Chiefs of Staff, on the basis of later information, enlarge the mission.

Assuming that the 137-wing Air Force order stands, the industry's task will be to keep that Air Force modern, equipped with the latest technological advances for service in the first line of combat duty. Outmoded weapons will be retired to USAF's second line.

For example, the B-36 is our current long-range inter-continental bomber, a first-line weapons system. By degrees, it will be replaced by the faster, high-flying eight-jet B-52. The Convair colossus will become a second-line aircraft, possibly for use as an aerial tanker.

▶ **Programs and Analysis**—Proper phasing of weapons systems on an annual basis, so USAF will have what it needs to perform its mission this year and next and the years thereafter, has been the concern of AMC's plans and programs office, headed by Col. M. S. Benedict. Under last month's reorganization, this group has been renamed as the Programs and Analysis Office. The new chief is Col. Richard H. Uhle.

It is from this office that the Deputy Director/Procurement must have a listing of weapons systems by category type before the aircraft industry can be approached to undertake design studies, the first step toward development of a new unit.

Categories of systems are:

- **Bombers:** heavy, medium and light, as well as bombing missiles.
- **Fighters:** day interceptors, all-weather interceptors, fighter-bombers, reconnaissance fighters and missiles.
- **Transports:** heavy, medium and light. The trend in heavy transports is to turboprop propulsion systems. Aerial tankers fall in this category.
- **Helicopters:** cargo and light.
- **Trainers:** The trend is toward jets, although USAF also is buying the prop-driven Beech Mentor.
- **Miscellaneous:** Into this category fall lightplanes, sea and air rescue craft and airborne early warning (AEW) aircraft.

The number of weapons systems needed in each category is determined annually at USAF headquarters. AMC reduces the schedule to a TMS (type, model, series) listing, a job that is done in cooperation with the Air Research and Development Command. Together, they are seeking "more Air Force per dollar"—the best possible weapons to fill the requirements at the lowest possible cost.

▶ **Background for Decision**—Major factors considered in their studies are:

- **Production feasibility.**
- **Time phasing of equipment** with the latest technological improvements in such fields as radar, communications, fire control, engines, bombing systems, photography, armament, propellers and all related components.
- **Evaluation of contractor's proposals.**

From this data and ARDC's advice on technical matters, AMC then draws up a weapons system schedule and submits it to USAF for evaluation. The schedule answers two vital questions:

- **When will USAF get the aircraft?**
- **How much will they cost?**

In more detail, the schedule also lists series, type, model, quantity, the contractor's facilities and time phasing.

Before going to USAF headquarters, the schedule is surveyed by AMC's chief, Gen. Edwin W. Rawlings, and his staff, including the vice-commander, his deputy for production, directors of procurement and production, supply and services, maintenance engineering, personnel and support, programming and the comptroller. In addition, the surgeon, judge advocate, quality control and office of information services may be called upon to join in the review.

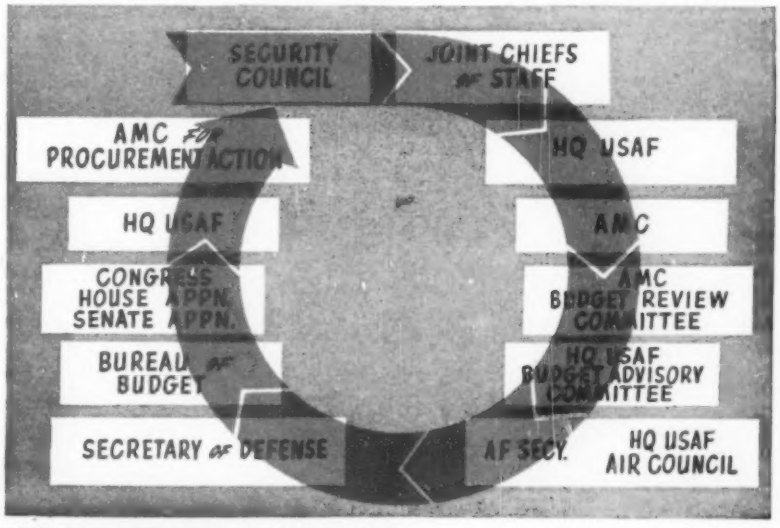
USAF headquarters next must determine whether the proposed procurement schedule provides the best possible answer to the mission requirement.

Evaluation is made by the Weapons Board, the Air Council—composed of the deputy chiefs of staff—and the Secretary of the Air Force. The best weapons systems for the customer—Strategic Air Command, Tactical Air Command, Air Defense Command or Training Command—must come out of this study.

▶ **Final Review**—Once these endorsements are won, the program moves up to the Secretary of Defense and the Bureau of the Budget, which represents the White House. It is finalized and frozen, usually by the Christmas season, and makes its first appearance as a requirement when the President discusses the State of the Union and the budget in his January messages to Congress.

Congressional review of the program, with hearings by Senate and House committees, follows in the spring. Here USAF defends its weapons systems proposals. Changes made necessary by budget cuts are incorporated.

By July 1, AMC has its procurement directives from USAF and the contractors are called in. At the Programs and Analysis Office, the next cycle already is under way. ■ ■ ■




HOW AMC GETS BUYING REQUIREMENTS

# Reshuffle Clears Procurement Channels

**An internal reorganization was put in effect last month in the Directorate of Procurement and Production, headed by Maj. Gen. David H. Baker.**

**The changes will benefit the weapons system contractor by reducing his points of contact with the Air Materiel Command and permitting him to confer with offices holding authority and responsibility.**

Actually, Gen. Baker sees the reorganization mainly as an effort to improve his internal housekeeping and cope with the global nature of AMC's procurement problems.

▶ **Cleared Channels** – The general describes the new setup as similar to that of a large industrial concern. It elevates former branches to division status and creates three deputy directors. The division heads will report directly to Gen. Baker, not by way of an intermediary.

Under the old table of organization, branches concerned with such items as field procurement, contracts, aircraft, electronics, industrial resources, etc., were operated under one of three divisions – Field Operations, Procurement or Production and Resources.

## New Directorates

It was felt that staff and operating functions were not properly separated, responsibility was divided and that it was impossible properly to delegate authority below the director level.

"Our new organization," Gen. Baker said, "will have a Deputy for Procurement, a Deputy for Production and a Deputy for Mobilization Planning. Their functions will be similar to those of vice presidents charged with corresponding responsibilities in industry.

"Our reorganization has become necessary in the light of the many new responsibilities with which the Directorate has been charged since 1948. These include decentralization of a large percentage of procurements and a vastly increased span of operations in off-shore procurement and production."

▶ **Reorganization Goal**–Goal of the reorganization plan is to achieve these improvements:

• **Separate staff and operating functions** to improve controls, fix responsibility and allow maximum delegation of authority.

• **Give the contractor one point** of contact for business on procurement and one point for business connected with production.

• **Provide increased emphasis** on the surveillance of world-wide procurement activities.

▶ **Deputy Directors** – The three new deputy directors are:

• **Brig. Gen. William T. Thurman,** Deputy Director, Procurement, will exercise staff surveillance over all USAF purchasing. This includes foreign buying, field procurement, local purchases by other commands and major procurement by ARDC.

Gen. Thurman also will direct purchasing in the Air Materiel Areas, AF depots and local purchase activities, in addition to any buying functions assigned to divisions of Gen. Baker's directorate.

• **Brig. Gen. Clyde H. Mitchell,** Deputy Director, Production, is in charge of production functions all over the world, including AMC field activities and the overseas commands. He is vested with authority over such manufacturing resources as machine tools, facilities, manpower and materials needed for current production.

It will be Gen. Mitchell's job to solve major production problems and maintain surveillance over requirements, configuration, engineering changes and delivery schedules. He will also be responsible for the facility capability report system.

• **Col. Vincent T. Cannon,** Deputy Director, Mobilization Planning, will fill a post putting new emphasis on the importance of planning by the aircraft industry. Formerly handled at branch level in the old Production and Resources Division of the Directorate, these responsibilities now will be at staff level.

Col. Cannon will review, evaluate and disseminate mobilization requirement schedules in preparation for M-Day.

He will develop and recommend policies and procedures that should be included in procurement plans.

The industry can expect more intense activity from Col. Cannon's office in the general field of industrial mobilization plans. He will set up a program to insure preparedness and improve the producibility of what comes off the assembly lines.

## New Divisions

The six new divisions that were created in the reorganization of the Procurement and Production Directorate will be directly responsible to Gen. Baker. When they work on procurement, production or mobilization they will report to the deputies responsible for those activities. The divisions:

• **Aircraft,** formerly a branch in the procurement division.

• **Aeronautical Equipment,** will take over the functions of the old Aeronautical Equipment and Electronic Branches of the procurement division.

• **Airlines, Maintenance and Service Contracts,** formerly a branch in the Procurement Division.

• **Readjustment,** formerly a branch of the Field Operations Division operating.

• **Support,** will take over the functions of the old Production Control Office and the Procurement Support Branch.

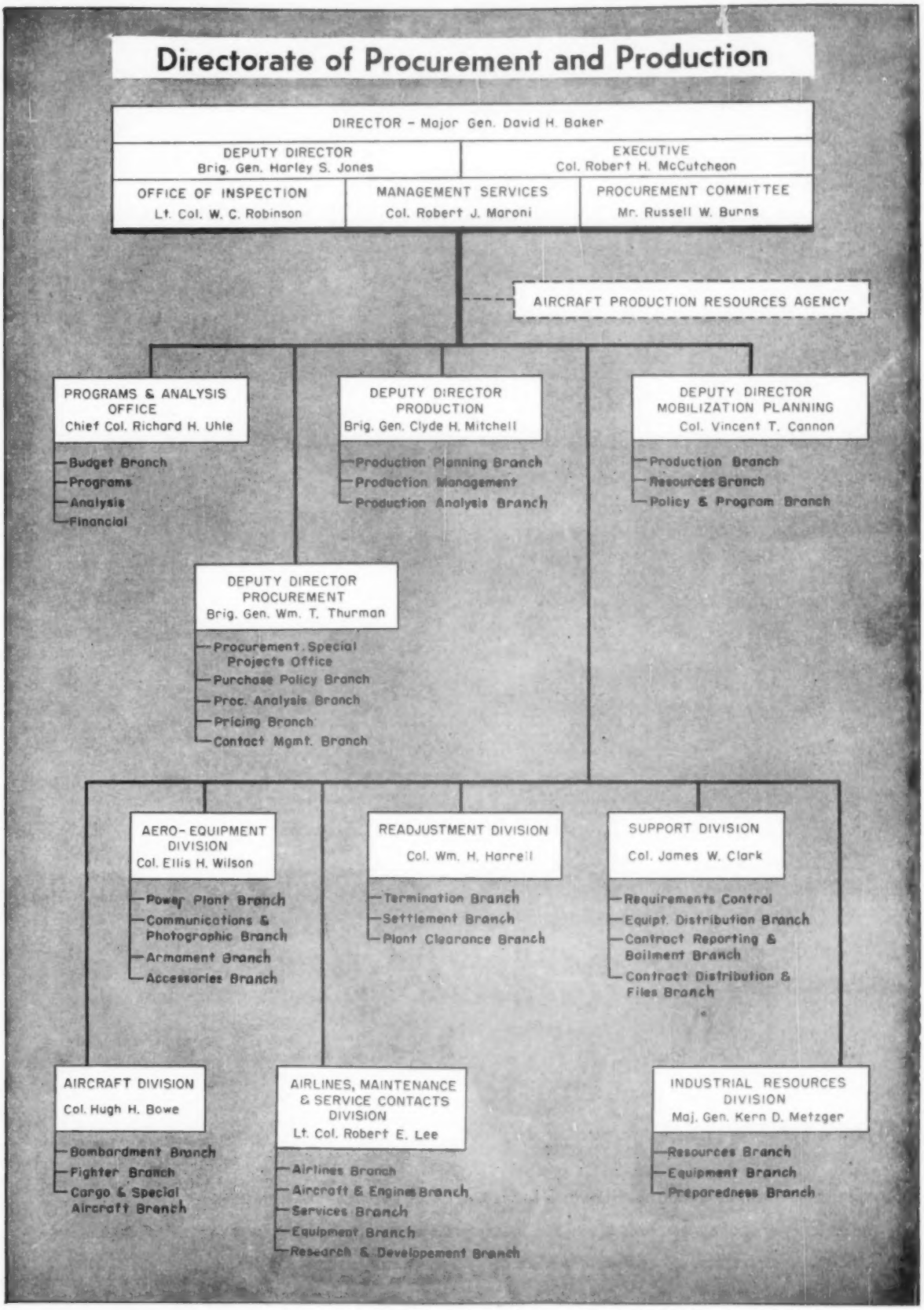
• **Industrial Resources,** formerly the Production Resources Division.

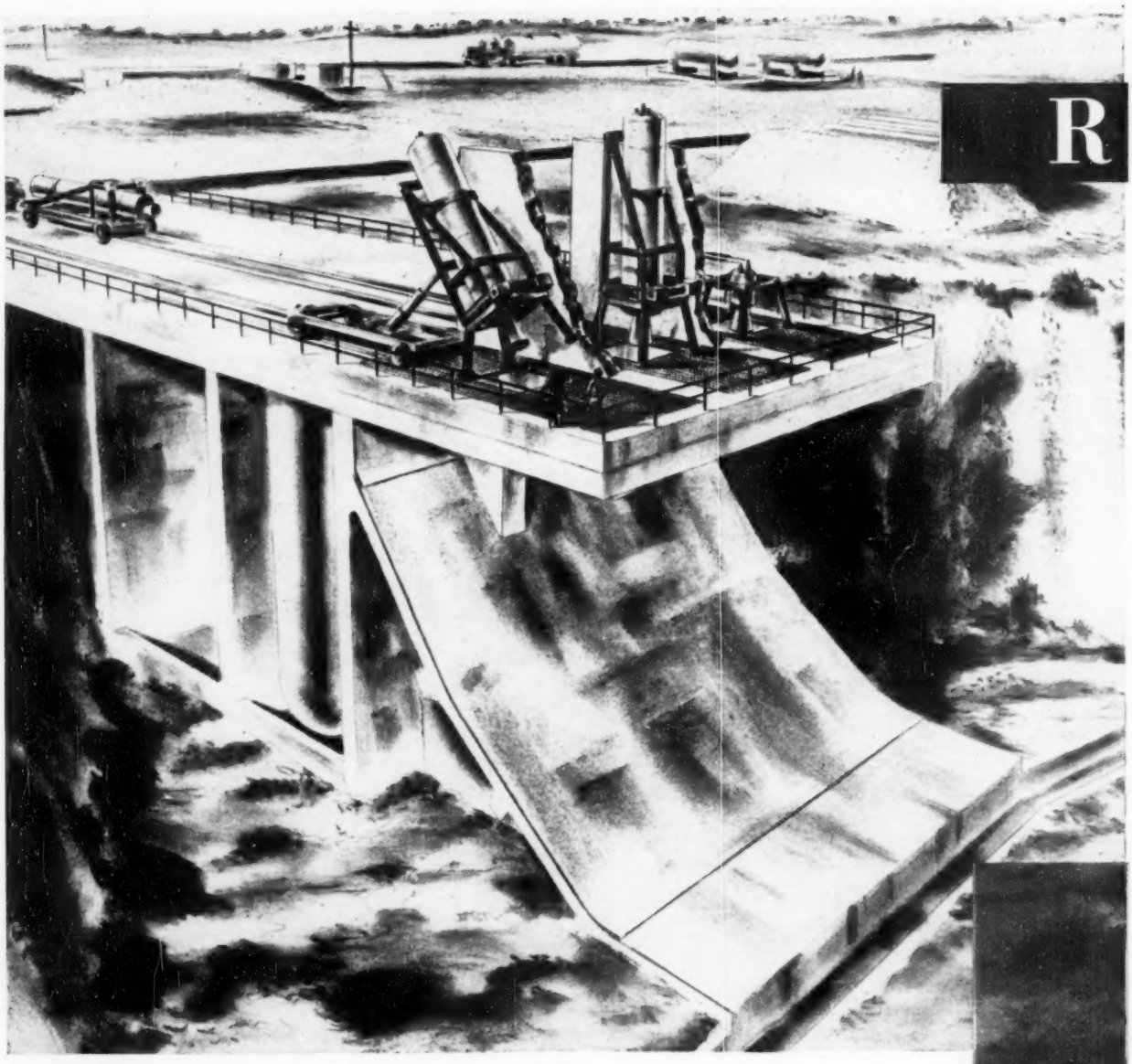
Research and development procurements formerly assigned to the R&D branch now will be bought by those buying divisions which deal with the specific commodity. ■ ■ ■

**BRIG. GEN. C. H. MITCHELL**
Deputy Director for Production

**COL. HUGH H. BOWE**
Aircraft Division Chief

# Directorate of Procurement and Production





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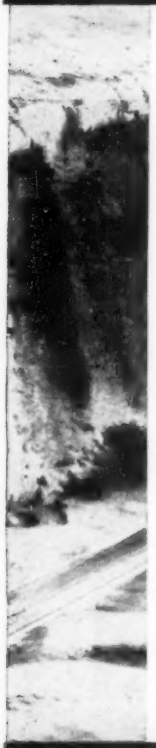

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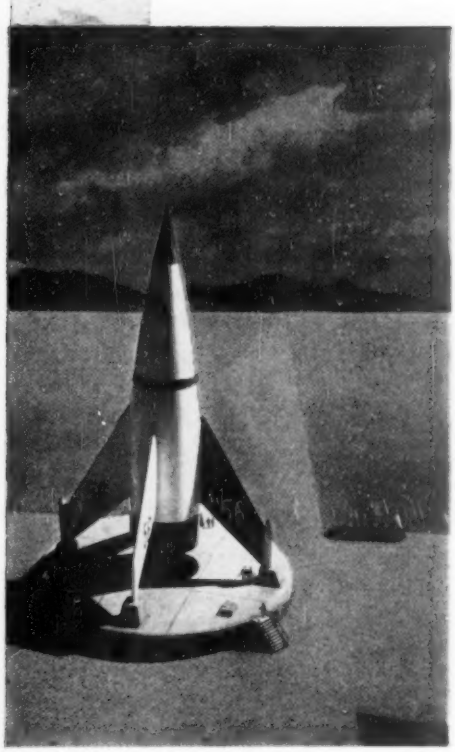

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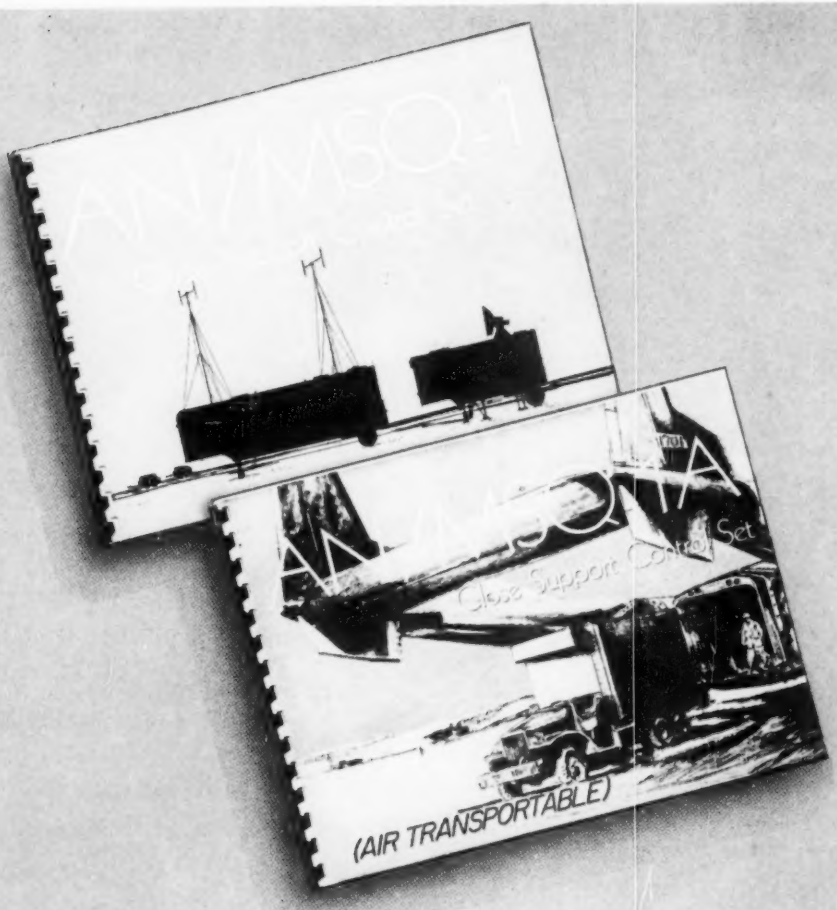


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**PROCUREMENT COMMITTEE MEETS.** From left, P. L. Hoefler and L. R. Poe (both no longer with committee), E. W. Brackett, J. H. Frost, L. A. Mincer, chairman R. W. Burns, and F. W. Stratton. Committee members L. R. MacGregor and G. R. Hodge are not shown.

# 'Court' Double-Checks AMC Contracts

Air Materiel Command's "court of review" for contracts is the Procurement Committee, a seven-man group of civilian specialists in the major facets of procurement.

The committee, which operates as a staff office of the Director of Procurement and Production, is basically responsible for:

- **Objective examination of all aspects of purchasing and contracting documents that exceed $350,000.** Committee may, if its desires, examine any contract, regardless of kind or amount.
- **Review and recommendation of new procurement policies.**

Procurement Committee was formed in January 1948, shortly after the Air Force became a separate service. Formerly the procurement procedure required that all large contracts be forwarded to the Secretary of War for approval.

## Faster Handling

Industry complained about the length of time required for processing contracts, and the Air Force delegated the authority to the Commanding General at AMC. Formation of the Procurement Committee followed quickly to assure similar handling of major contracts, main virtue of the War Department review.

▶**Is the Deal Sound?**—Procurement Committee has one cardinal, overriding question to answer in its analysis of a contract: Is it a sound business deal for the Air Force?

The main elements of the contract are examined in detail. They are:

- **Pricing.**
- **Type of contract.**
- **Technical features.**

Russell Burns, chairman of the committee and a member since its formation, explains the committee's work:

"We must look at a contract in its entirety. It's a matter of balance. In some cases the price may be lukewarm from our viewpoint but other factors may produce good reasons for the price. We believe in paying a manufacturer what he earns.

"You cannot use a rigid system of measuring profit. There are elements involved (including the risk) such as the amount of government financial assistance, the complexity of the item, the efficiency of the operation and the nature and degree of subcontracting," Burns says.

▶**Two-Man Review**—Every contract referred to the committee is reviewed by at least two members who must concur. If they fail to agree a third member, usually the chairman, is brought into the discussion. If the dispute is not resolved among the three members, and it involves a major policy, a full report on both sides of the unresolved questions is furnished to Maj. Gen. David H. Baker, Director of Procurement and Production, who makes the final decision.

Contracts referred to the committee first pass through a checking phase to assure that such essential papers as a facility capability report are contained in the contract folder, and that the mathematics of the contract are accurate.

There is no special system of referring contracts to individuals for review. They are assigned to committee members on a rotation basis. All members, of course, are available for informal consultations on points involving their specialties.

The committee reviews contracts that account for approximately 70% of the funds expended by Air Materiel Command. During Fiscal 1953, the committee processed 5,036 documents, of which 2,372 were formal contracts.

Members can approve deviations in standard contract provisions with the exception of those that do not conform with Armed Services Procurement Regulation, supreme guidance factor in procurement for all three services. Contract deviations from the ASPR, if concurred in by the committee, are sent to USAF headquarters where the Air Force touches base with the Navy and Army.

▶**Policy Decisions**—The committee is also a source of procurement policy.

Recent committee project completed by former member Lloyd R. Poe, who has been named chief of the purchase surveillance section, was the consolidation of the 2,250 separate regulations dealing with Air Force buying. He assembled all the regulations and instructions—United States Air Force Letters, Air Force Regulations, AMC Regulations and Letters and other guides and orders that made a formidable stack reaching 3½ ft. Many of the regulations were duplicates; others contradicted previous instructions. Poe keyed his consolidation to the ASPR numbering system. He managed to compress all the procurement rules into a tidy volume of 1,200 pages.

Committee must make two important checks on advertised purchases:

- Does the advertisement describe accurately the requirement?
- Does the manufacturer's bid conform to the requirement?

## Committee Personnel

The committee brings a broad total of experience to bear on a contract.

The organization, in addition to Burns, who is a pricing analyst, includes two lawyers, an acronautical engineer, another pricing analyst, a school and training expert, and a professional diplomat who once served as Australia's ambassador-at-large to South America.

Members of the committee and their background:

- **Russell Burns**, committee chairman, is a native of North Dakota. He attended high school in Duluth, Minn., then was graduated from Hamline University, St. Paul, Minn., the same school that Gen. Rawlings attended. He majored in economics at Hamline and later acquired an accountancy degree

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from LaSalle Extension University.

Burns worked in a Duluth bank as manager of the collection department and then credit manager of the Minneapolis branch of the Universal Credit Co., later joining Investors Syndicate as auditor of the company.

He entered federal service in 1942 with the Air Technical Service Command, predecessor of the Air Materiel Command. Burns organized and directed the first Price Analysis Group for airframes, engines and propellers. He remained in that position until 1948 when he was tapped for membership in the Procurement Committee.

Burns, who has gained as reputation as AMC's "senior civilian statesman" in the procurement field, says that "price analysis is an art, involving many factors."

"In analyzing a price," he says, "it is necessary to review all elements of the price and usually take a long look ahead and attempt to figure trends in material costs and labor rates. Certain contracts run as long as four years.

"In relatively simple contracts it is still necessary to understand factors that make up a price. If we are asking for a short delivery time on a large quantity, that fact could affect the price since the manufacturer might be forced to subcontract parts of the job. If we are asking for substantially larger quantities than in previous orders, we should determine if the company might have to set up new lines and purchases. All of these factors must be considered in determining a reasonable price that is fair to the Air Force and the manufacturer," Burns says.

• **Ernest W. Brackett,** a 51-year-old lawyer from Mohawk, N. Y., has a solid background of law and procurement. He is a graduate of Cornell University and has been admitted to practice before the U. S. Supreme Court. He practiced law with a Utica, N. Y., firm and served as president of the Utica Rotary Club.

Brackett entered the Army in 1942 when he was called up as a reserve officer. He was assigned as a contracting officer at Middletown Air Depot and Rome Air Depot. In 1944 he was transferred to Wright-Patterson AFB as chief of the local purchase section.

Following Brackett's discharge in 1946, he became civilian chief of contracts branch at Air Force headquarters. He served on the ASPR committee and transferred to the Procurement Committee in 1950. He recently redrafted 26 standard Air Force contract forms.

• **Lionel A. Mincer,** 52, is a lawyer on the committee and, along with chairman Burns, a member of the original committee.

He is a native of Kansas, a graduate

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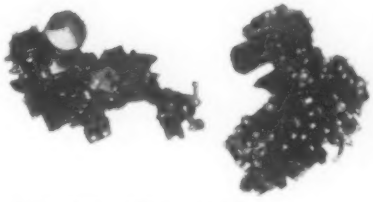

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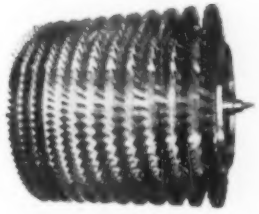

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of the University of Kansas and Harvard Law School. He practiced law in Chicago until 1942, when he entered military service and was assigned to Wright-Patterson. He has been there ever since.

Mincer served as a contract writer in the procurement division during World War II, and was chief of the legal branch for two years before joining the committee in 1948.

He is responsible for setting up and conducting a school for buyers and edited the first handbook on local purchasing procedures and policies.

• **Frederick W. Stratton,** 51, joined the committee in February 1951 after 18 years of civil service duties with the Veterans Administration in Cincinnati. He specialized in handling school contracts with the VA and is the committee's expert on training contracts.

• **G. Reid Hodge,** 33, is the youngest and most recent member of the committee. His specialty is purchasing procedures and price analysis. He studied industrial engineering at the University of Illinois and, after working briefly in private industry, entered government service in 1942 with the Army Signal Corps at Wright-Patterson as an engineer in the radio laboratory. He later studied electrical engineering at the University of Michigan.

Hodge became a buyer with AMC in the armament section in 1948 and three years later was named chief of the procurement office of the electronics branch. He had worked closely with the committee before being named a regular member of the unit. Hodge assisted in the preparation of the contracting officers' handbook.

• **Lewis R. MacGregor** brings the diplomatic touch to hard-headed bargaining over contract terms. MacGregor, now retired from Australia's foreign service, was born in Scotland. He is a law graduate of Glasgow University and later acquired a degree in accountancy in Australia.

MacGregor joined the Australian government service during World War I, transferred to the foreign service in 1919. He served 31 years in various diplomatic assignments, rising to the rank of ambassador. He headed missions for the Australian government in Europe, Canada, Asia, Africa, and South America. He negotiated the first trade treaty between Australia and Canada in 1930.

During World War II MacGregor was Director General of the Australian War Supplies Mission to the U. S. and Canada. He met Gen. Rawlings while engaged in that assignment. After retiring, MacGregor decided to live in the U. S. in order to be with his children.

Gen. Rawlings heard about MacGregor's presence in the U. S., and asked him to join the AMC staff on a temporary basis. "I decided to take the job for three months," MacGregor says, "and I've been here three years."

MacGregor is available for special assignments by Gen. Baker.

MacGregor recently acquired U. S. citizenship. He is presently employed at AMC on a consultant basis. "My background in law, accountancy and diplomacy has been a great help," MacGregor says. "There is not a great deal of difference between a diplomatic agreement and a commercial contract. The principles are the same: two parties seeking to reach a meeting of minds.

"I look at a contract by these lights," MacGregor says, "Is this a deal that will get anyone into trouble? Does it have political implications? How will it reflect on the command? Is it in the best interests of the government?"

• **Joseph H. Frost,** 38, is a West Point graduate, a pilot and the engineering professional on the committee. He has a master's degree in engineering administration from Stanford University and attended the aeronautical engineering school at Wright-Patterson.

During World War II, Frost set up a B-17 mechanic training school and organized the first mobile units for mechanics. He figured prominently in the development of "cruise control" techniques that increased bomber ranges.

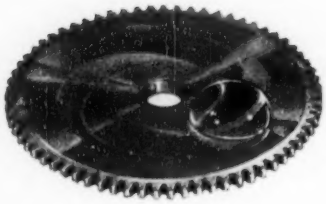
Frost was then assigned as engineering officer for the first B-29 wing, and later became director of training for the 20th Bomber Command. He accompanied the command to the China-Burma-India theater when the unit arrived in northwest China for its strikes directed against the Japanese home islands.

He was then assigned to Wright-Patterson AFB where he was coordinator of aircraft design. After a second overseas tour in the Pacific, Frost returned to the U. S. and was assigned to air defense duties on the West Coast. He resigned his commission in 1951 and joined AMC as a buyer. He became a member of the Procurement Committee in October 1952.

His engineering knowledge is a strong factor in influencing decisions that involve the purchase of technical equipment.

Example: Frost's knowledge of the complexity of constant-speed drives, which are used to regulate the speed of generating equipment, was the deciding factor in approval of a high-cost source for the item. Frost pointed out to the committee that lower bidders had not demonstrated their ability to produce the equipment and the need was urgent enough to require approval of a proven, though more expensive, source. ■ ■ ■

moisture is a gremlin



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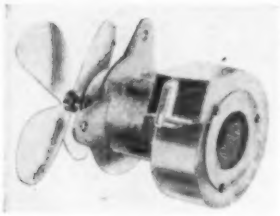
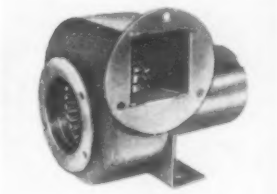


A15ABF-1 115 Volt — 400 cycle. Blower delivering 50 CFM at 8500 RPM. Propeller fan delivering approx. 300 CFM at 8500 RPM.

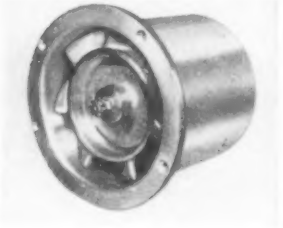


B20B3—115 Volt 400 cycle single phase centrifugal blower. Delivering 140 CFM of air against 2" of water operating at 6500 RPM minimum.

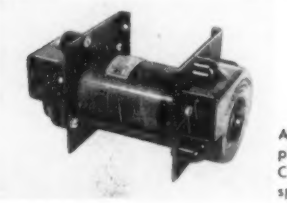
A08C1—2 phase control motor for operation on 60 cycle supply 115 Volt on one phase and 40 Volt on control phase. 3.0 oz/in starting torque on above voltages. 1500 RPM. No load speed.

A15AD3—Axial blower unit for operation on 115 Volt 60 cycle single phase supply at 3300 RPM delivering 35 CFM at 0.2 S.P. This unit has special mounting bracket.

A15HF—115 Volt 60 cycle single phase capacity start & run sychronous motor running at 3600 RPM. This unit has special terminal block mounted on end of motor.

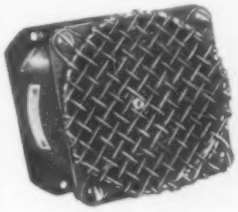


450C-1—115 Volt 400 cycle phase axial—vane type blower delivering 200 CFM at 6 S.P. Weight approx. 5 lb.



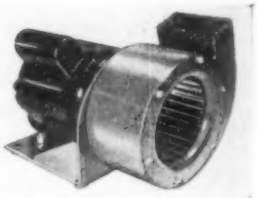
A15BD—115 Volt 400 cycle single phase double blower delivering 26 CFM total at 0 static. This unit has special mounting brackets.

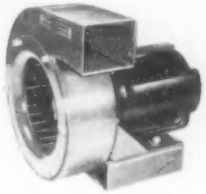
A11A-1—115 Volt 400 cycle single phase propeller type blower using 4" 4 blade fan.



A11A-2—115 Volt 400 cycle single phase axial vane blower delivering 70 CFM at 1" static pressure at 11,000 RPM.

631 x 35 115 Volt, 60 cycle or 220 Volt, 60 cycle, 1 or 3 phase. 3450 RPM continuous duty. 250 CFM at 2½" water gauge. Used in microwave generators, unattended repeater stations. Fits in space 13½" long, 8¾" wide, 7¾" high.





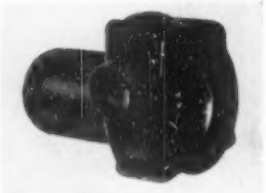
631 x 1—115 Volt, 60 cycle, 3450 RPM 100 CFM @ 2½" water gauge. Fits in space 9½" long, 8¾" wide, 7¾" high.

Variable frequency blower for operation on 115 Volt single phase. Available with axial fan or centrifugal blower.

A15BF-15—50 to 800 cycles—single winding available with axial fan or centrifugal blower.

A15AB-2—50-60 cycle and 400 cycle operation single winding.

A15CF10—50-60 and 320-1000 cycle operation dual winding.



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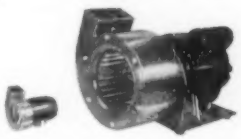

**The motors and blowers on this page are representative of the many varied models available. Detailed information specifications and performance data on all the above units available on request.**

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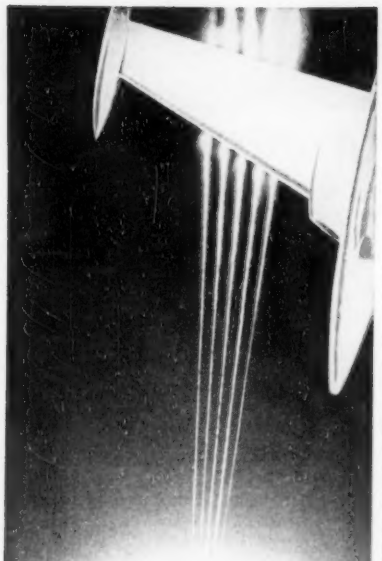

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# How AMC Fights Fraud, Bribery

By G. J. McAllister

**Office of Inspection in Air Materiel Command's Procurement and Production Directorate is jocularly termed by the AMC staff the "Sin, Sex and Fraud Section."**

**The facetious terminology has some elements of accuracy, but falls short of a complete description.**

Basically, the assignment of the Inspection Office is:

- Analyze and recommend action on reported violations of the "gratuities clause."
- Handle inquiries from individual members of Congress or congressional committees concerning Air Force-wide procurement.
- Advise procurement personnel in their relations with debarred, ineligible, suspended or dissatisfied bidders, and submit to USAF headquarters recommendations concerning the elimination or addition of firms to the debarred, ineligible or suspended list.
- Process contractors' representatives, affidavits.

Other Office of Inspection functions deal with internal AMC administrative matters and similar relations with other federal agencies.

▶ **No "Private Eyes"**—Office of Inspection is not a "private eye" type of organization. The staff of four officers and 10 civilians, headed by Lt. Col. William C. Robinson, judges and acts on facts presented by a purely investigative agency, the Office of Special Investigations, which is directly controlled by USAF headquarters. Col. Robinson's office works closely with the Office of Special Investigations. OSI investigators, like Federal Bureau of Investigation agents, do not draw conclusions; that is the function of the Office of Inspection.

Example of the interlocking function is the case of the high-living first lieutenant: An Air Force officer came to Col. Robinson and told him about a first lieutenant who had two new automobiles, a $30,000 home and an apparently unlimited supply of spending money. It didn't seem right, the informant said.

Col. Robinson sent the report to OSI and requested an investigation. OSI later called in the FBI when evidence of bribery was uncovered. The lieutenant was in charge of selling surplus property at a base and had shown favoritism to a firm bidding for the properties. In return, the firm paid the officer $24,700 in "gratuities." The case was swiftly prosecuted and the lieutenant sentenced to a five-year term. Officials of the firm received sentences up to eight years each.

Most of the gratuity cases do not involve such large sums or such clear-cut evidence of bribery. A junior officer at AMC was charged on 14 counts of accepting gratuities from various manufacturers. The gratuities ranged from a coffee percolator to a pair of tickets to "Guys and Dolls."

The total value of all gifts amounted to about $100. The officer was brought before a court-martial, found guilty on six counts, fined $1,500 and given an official reprimand but retained in the military service.

▶ **Basic Principle**—A basic Air Force procurement principle was the basis of the case against the officer: Procurement personnel shall not accept gifts from industry representatives who are doing or plan to do business with the Air Force. The size of the gifts was not a major factor in the court's decision.

## One Master Only

A civilian buyer purchasing electronic equipment for AMC pleaded guilty to accepting gifts of money totaling $900 and a radio. He admitted in a federal court trial that he accepted the money in connection with contracts he was handling. He testified that during an 18-month period he negotiated contracts for the government totaling about $250 million. The civilian employe was sentenced to 18 months, and company official involved was sentenced to three years and fined $3,000.

▶ **One Master Only**—"You cannot serve two masters," says Col. Robinson. If a buyer at AMC receives a gift, even a small gift, from a representative of a company seeking a contract the buyer might develop a feeling that it is necessary to reciprocate. Most of the gifts are paid for, one way or the other, by the taxpayer.

"We want to prevent the necessity of reciprocation by setting up and enforcing rules against the offering and acceptance of gratuities of any kind," Col. Robinson says.

▶ **Do's and Don'ts**—A sign in the reception building to the procurement offices of AMC states:

"In conformance with federal statutes, it is essential that Air Force contractors and potential contractors refrain from offering gratuities to government em-

ployes at this installation. It is emphasized that both giver and receiver are subject to prosecution for violation of the 'anti-gratuity' statute."

AMC has issued a "Do's and Don'ts" booklet for its employes on the gratuity problem.

• **Main DON'T:** "Don't accept gratuities **in any form** regardless of value from present or potential contractors, their representatives or others interested in the award of contracts to any firm, whether or not you believe they are intended to influence your official actions or decisions. Acceptance of any gift or favor, however small, will not only embarrass the Air Force but may subject you to loss of your position and criminal prosecution. The fact that you are not directly involved in a procurement matter does not justify your acceptance of a gratuity, inasmuch as mere acceptance, regardless of the circumstances, may subject you to penalties. . . ."

• **Main DO:** ". . . There are, however, situations and conditions where the acceptance of social amenities from a contractor may be appropriate. For example, it is considered unobjectionable and in the interest of the Air Force from a public relations standpoint to (1) attend dinners or banquets sponsored by industrial associations where contractors' representatives and government personnel are invited; (2) occasionally accept lunch or dinner at a contractor's plant where personal payment is impossible or embarrassing; (3) attend functions sponsored by defense contractors to inaugurate the opening of a new plant, tests of new aircraft, and the like."

▶ **Briefing on Conduct**—AMC has arranged a briefing session for new officers and civilians assigned to procurement. Office of Inspection's role in the briefing consists principally of outlining a "standard of conduct" for procurement personnel:

Main points of the standard:

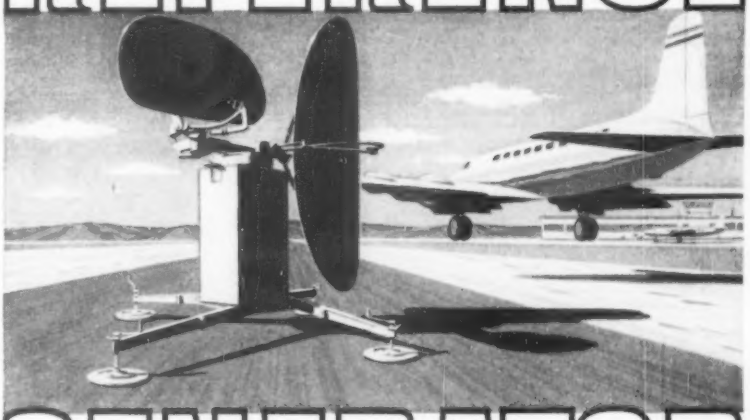
• Procurement personnel have a high degree of trust, and must not only avoid evil but also the appearance of evil.

• They must avoid such unethical practices as disclosure of pre-award information, social relationships that may cause criticism, expression of personal opinions on procurement matters and unauthorized commitments.

▶ **A Matter of Price**—Newcomers are also told an apocryphal story in connection with their briefing:

A young lieutenant rushed into his colonel's office at AMC one day and excitedly reported that he had been offered $1,000 to favor a certain firm in a contract award. "What should I do?" he asked the colonel. "Why, you can do only one thing as a man of high morals and principals: Turn down


REFERENCE



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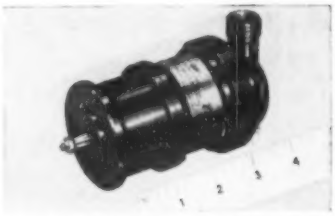

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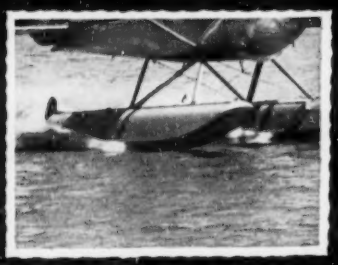

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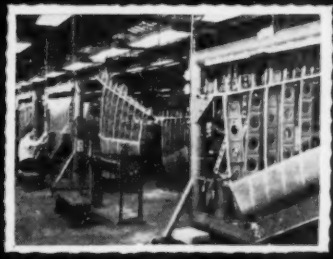
**RESEARCH.** Edo's staff of scientists and engineers, experienced in many fields, is undertaking a variety of research projects.

**COMPONENTS.** Edo builds fins and rudders for F-84 Thunderjets; also builds external stores housing for electronic equipment.



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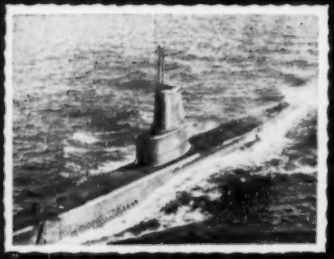

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**NEW HULL SHAPES,** built, flight tested and evaluated by Edo, have contributed much to the improved performance of flying boats.

**DEVELOPMENT** from initial conception to completed design is unique Edo ability. Example: the Edo OSE scout observation plane.

# *Edo's Picture Album of* ***DIVERSITY . . .***

## *. . . the Result of* ***PERFECTION***

Only a brief glimpse into the vast scope of Edo's diversified activities is afforded by these pictures.

Such outstanding talent in so many fields amazes all — especially those who have known Edo for over a quarter of a century as designers and builders of the world's finest seaplane floats.

In the broad fields of aviation, marine and electronics, Edo has made and is making many outstanding contributions. Yet, as diversified as Edo's operations are, ONE fact stands out. Edo can take an idea, translate it into a superior product, device or system, and then *build* it.

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the offer," the colonel advised.

A few days later the lieutenant was back again. "Colonel, I've just been offered $3,000 to throw that contract," he said. "What should I do now?"

The colonel's reply remained: "Turn it down."

Two weeks later the lieutenant again appeared before the colonel, more excited before. "Colonel," he gasped, "I've just been offered $25,000 on that contract deal. What about it now?"

The colonel's answer, a little more vehement, was still: "Turn it down?"

"I know, I know," the lieutenant said, "but they're getting awfully close to my price."

▶ **Meyers' Case**—The Office of Inspection was formed in August 1951 when Gen. Edwin W. Rawlings assumed command of AMC. It was specifically aimed at preventing a recurrence of the "Benny" Meyers case, a classic in gratuity acceptance. The office was placed in the Procurement and Production Directorate because it handles all purchasing for the Air Force. Col. Robinson says:

"When money and people are together there will always be opportunities for fraud." Production and Procurement has plenty of both: 10,645 military and civilian employes who during fiscal 1954 were responsible for net obligations of about $2.5 billion.

In addition there are many others who buy by petty cash in sums totalling into millions of dollars.

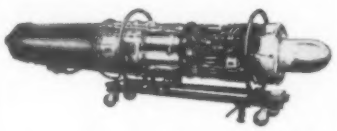
Approximately 95% of the fraud cases involve procurement. Most of the information leading to investigation come from tips supplied by employes.

"AMC employes live in a goldfish bowl," says Col. Robinson. "For instance, if a buyer accepted an invitation to a golf game from a manufacturer's representative and they are seen together, an immediate suspicion may develop concerning their relationship. That suspicion must be avoided."

"In our decisions on possible actions, we let the punishment fit the crime," he says. "Suppose an AMC buyer visits a seller in his hotel room and they have a social evening together. If this incident is reported to us and proven by investigation we would consider the individual's past record before recommending action. It might consist of just a 'chewing out'."

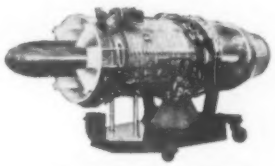
▶ **Dangerous Patterns**—Maj. Gen. Phillips W. Smith, AMC's comptroller, put the gratuity problem in sharp perspective in a recent speech before the National Association of Purchasing Agents.

"I think we all realize that there are an isolated few who are careless or unprincipled," Gen. Smith said. "They are responsible for the growth

GENERAL ELECTRIC

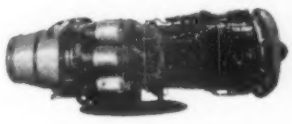
PRATT & WHITNEY



WRIGHT AERO

ALLISON

WESTINGHOUSE



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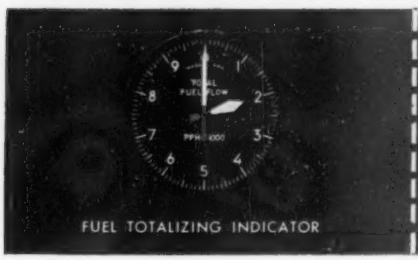
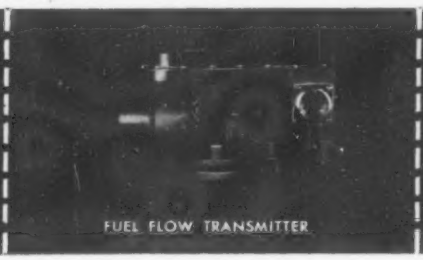
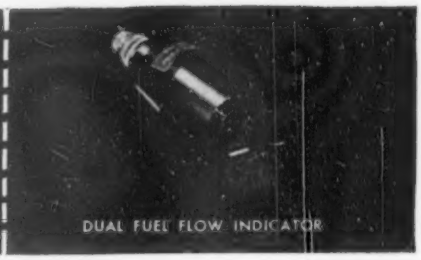


FUEL TOTALIZING INDICATOR



FUEL FLOW TRANSMITTER



DUAL FUEL FLOW INDICATOR

**Electronic control devices are among the many instruments Ketay manufactures for aircraft, missiles, marine, ordnance, and civilian application. Special designs to meet the limitations of space and operating conditions.**

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**Inspection of all parts, sub-assemblies, as well as completed instruments, is a fetish at Ketay. For instance, all bearings are inspected with specially developed equipment in air conditioned work space. This is just one of the many techniques that assure maximum performance when Ketay units are specified.**

**electro-mechanical devices some of which are illustrated on these pages. Currently, original Ketay developments are providing instrument performance far above present standards—many of which were set by earlier Ketay developments.**

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**Precision of manufacture is vital in every Ketay unit. To assure continuing reliability for its products, Ketay employs the very latest facilities and techniques. Typical is this "gear room" where modern gear cutting machinery produces gears to the finest of tolerances.**

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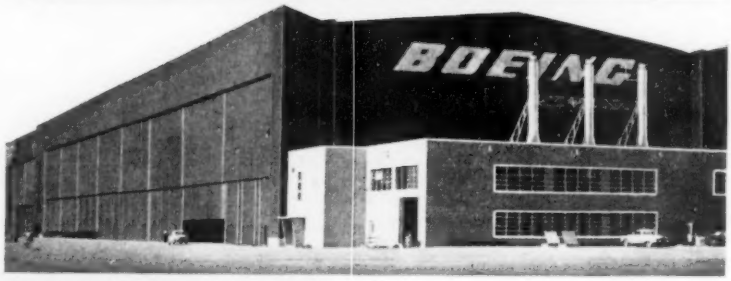
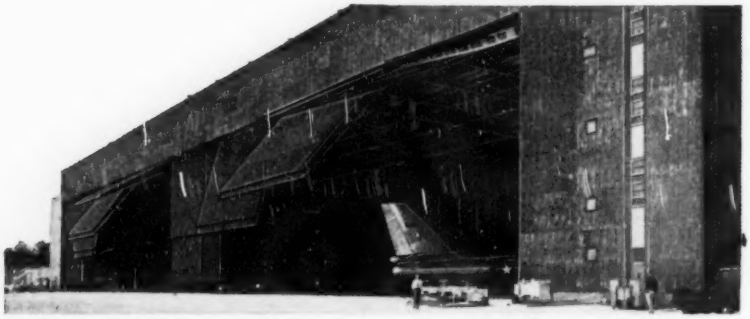
Projects pictured here are recently completed examples of International hangar door installations at aircraft production plants throughout the country. In each case the doors were designed by International engineers to meet specific, unusual circumstances.

ABOVE: Telecanopy Hangar Doors at **BOEING B-52 FLIGHT HANGAR,** Seattle, Wash.—designed, fabricated and erected by **INTERNATIONAL**—world's longest door of its type for the world's most powerful bombers.

# Nation-Wide it's INTERNATIONAL FOR AVIATION DOORS




RIGHT: **INTERNATIONAL-BUILT ENTRANCE** at **BOEING B-47 FLIGHT HANGAR,** Wichita, Kansas—providing a total opening area of 95,000 square feet—world's largest entrance.



LEFT: **INTERNATIONAL 16-SECTION DOOR** At **LOCKHEED B-47 FLIGHT HANGAR,** Marietta, Georgia —affording a total entrance width of 1,056 feet.

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of patterns which, if applied solely to purchasing for commercial production would rapidly price themselves out of the scene. Unfortunately the suspension of some of the normal laws of competition, inevitable in our vast and rapid procurement of weapons during the last few years, creates circumstances under which they can develop if not checked.

"These are also times which can warp the moral perspective of a few weak or greedy men. The billion-dollar temptation of emergency military procurement exists, without the obvious patriotic restraints of war itself. We have with us the old, corrosive custom of the kick-back, which can rot the heart out of any budget, no matter how big. We have the sharp dealers, who ride the razor-thin edge of bare legality and slip sometimes from horse-trading to horse-stealing. And we have the men who set a shabby price upon their responsibility to their country.

"It is astonishing to realize that a man who would despise the profiteers who grew rich supplying tainted food and cardboard shoes to the Civil War troops can still somehow rationalize his own rakeoff in our present situation. He blinds himself to the fact that every bite he takes from our resources weakens us that much in our stand against the greatest threat our nation has ever faced," Gen. Smith said.

## How NAMR Feels

The National Association of Manufacturers Representatives believes the gratuity regulations are too strict. The NAMR was organized in 1951 as to exchange information on new government procurement policies. The organization has a membership of about 300, most of them based in Dayton and doing business with AMC. NAMR holds monthly meetings where they hear top government procurement officials clarify procurement problems, engineering changes and budget figures.

▶ **Boyles' View**—Palmer Boyles, president of NAMR, represents five firms in Dayton: Aeronca Manufacturing Corp., Soreng Products Corp., Switlik Parachute Co., Inc., Detroit Harvester Co. and Grand Central Aircraft Co. He is a former Air Force officer and once served as base commander at Wright-Patterson AFB.

Boyles says: "I believe the gratuity policy has been carried too far. It used to be that we could call a man at AMC and have lunch with him in the cafeteria and discuss business. It saved time for us and the government.

"I have never in my experience heard of anyone giving a contract to someone just because he had lunch with him. I am certainly against pay-offs in get-


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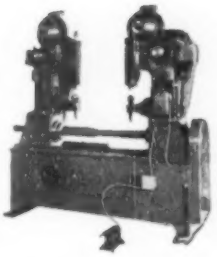
T-J

**RIVITORS**

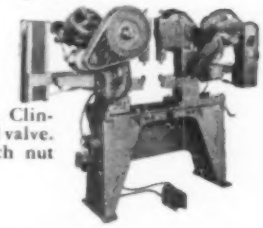
**T-J RIVITOR** used for automotive clutch plate assembly. Saves time and labor doing a four-fold job—assembling, setting, inspecting and ejecting.



**DOUBLE RIVITOR** sets two rivets at a time! Equipped with 10" hoppers, and tooled to automatically feed and set two ¼" dia. x ¾" long wagon box head rivets at a time in elevator chain and raddle or elevator flight assemblies for farm implements. Controlled by one foot pedal.

**CLINCHORS**

**T-J CLINCHOR** . . . one of six special 8" throat Underfeed Clinchors used by a large automotive body manufacturer. Feeds and sets 11/16" square cased nuts in outside quarter panels, left and right hand.



**DOUBLE CLINCHOR** sets two nuts at once! Tooled to feed and set ⅜" x ½" x 1/16" thick Fabri-Steel nuts at each operation. Both Clinchors tripped by same foot-operated valve. Adaptable to wide range of clinch nut setting problems.

**Automatic Feeding and Setting!**

T-J meets your needs for labor saving SPEED in assembly . . . with performance-proved Rivitors and Clinchors for many jobs today . . . in aircraft, automotive, farm machinery, stampings of all kinds.

T-J CLINCHORS set clinch nuts 3 to 5 times faster! Fully automatic . . . controlled by a single foot pedal! Available in Underfeed and Gravity feed models, throat depths 8" to 36".

T-J RIVITORS automatically feed and set solid rivets . . . with high production! Electrically powered Rivitor sets 1/16" to ¼" diam. solid steel rivets up to ⅞" long. Air-powered Rivitor sets aluminum alloy rivets up to ¼" diam. or steel rivets up to ⅛" diam. and up to ¾" long. Throat depths 8" to 36".

Write for Clinchor bulletin 847; Rivitor bulletins 646 and 847. The Tomkins-Johnson Co., Jackson, Mich.

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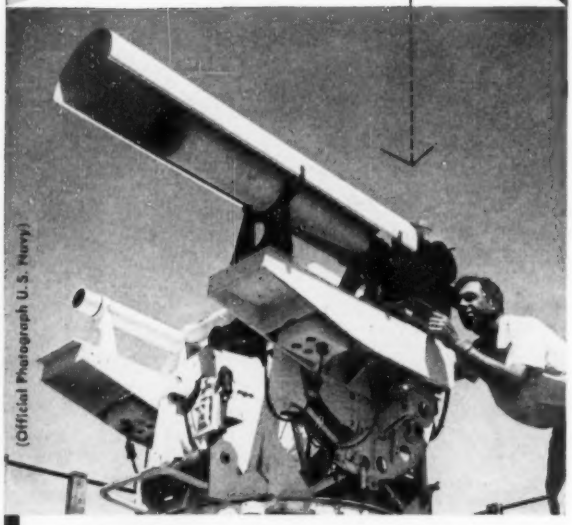

(Official Photograph U. S. Navy)

**tracking** with a 48 inch lens is this specially mounted Mitchell 35mm camera, at the United States Naval Ordnance Test Station at Inyokern, California. *Over 50 Mitchell cameras are regularly used at this test station,* including 16mm Hi-Speeds, 35mm Standards, 35mm Hi-Speeds, Chronographs and 70mm models.

Today Mitchell cameras are actively engaged in providing exacting high speed motion picture photography for research, development and test work throughout the world.

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ting contracts, and I would do anything in my power to see that a man giving a pay-off would be properly dealt with.

"The new policy has reached such an extent that I can't visit the home of an AMC employe and he can't visit mine. We can't play golf together or enjoy a normal friendly relationship. For instance, the gratuities forbidden by regulation cover such ordinary promotion items as pencils, calendars, blotters and even matchbooks.

"One of the representatives here had a subsidiary company that sold lighter fluid. The containers carried the name of his company and he thought it was a good idea to pass a few around for advertising purposes. The item must have been worth at least three cents. But they put a stop to handing out the can of lighter fluid.

▶**Self-Policing**—"We try to police our own organization. If a man doesn't conduct himself in an ethical manner we will discipline him by suspending or terminating his membership. We also serve as a focal point for complaints the Command may have regarding the conduct of manufacturer's representatives. Those complaints are considered at our meetings and we take action on them.

"Col. Robinson does a most efficient job in his inspection efforts. All he can do is follow the policies laid down by the Air Force. But they are much too strict and differ greatly from normal business practices between private firms."

## How OI Operates

The Office of Inspection during 1953 handled 1,900 cases involving fraud, congressional requests and bidders' protests. The cases are about equally divided among the three categories.

▶**Fraud Cases Up**—The number of fraud cases during 1954 probably will exceed those recorded in 1953 since many of the cases involve contracts that were let during the Korean emergency and are just coming to light.

"The odd thing about acceptance of gratuities," says Col. Robinson, "is that most of them do not have a permanent or a significant value. These include such things as free vacations, lavish entertainment or some item like a $20 cigarette lighter."

Col. Robinson is cautious about the action taken against contractors suspected of offering gratuities. "We take the necessary action to protect the best interests of the government," he says. Presumably this means that the contractors are placed on a list marked: "Look Out."

A large part of Robinson's personal time is taken up in dealing with dissatisfied bidders. "There are buyers who

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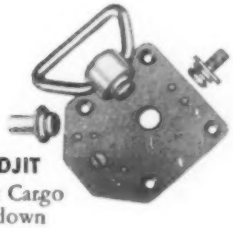
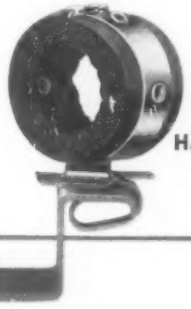
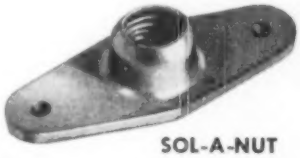


**WEDJIT**
Seat & Cargo Tie-down Fastener



**WIRE HARNESS BAND**
Non-chafing Snap-locking Clamp



**SOL-A-NUT**
Heat Resistant Stainless Steel Nut

**MONADNOCK MILLS**
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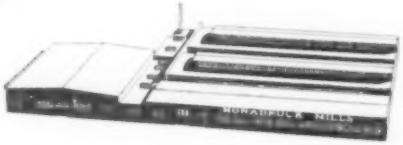

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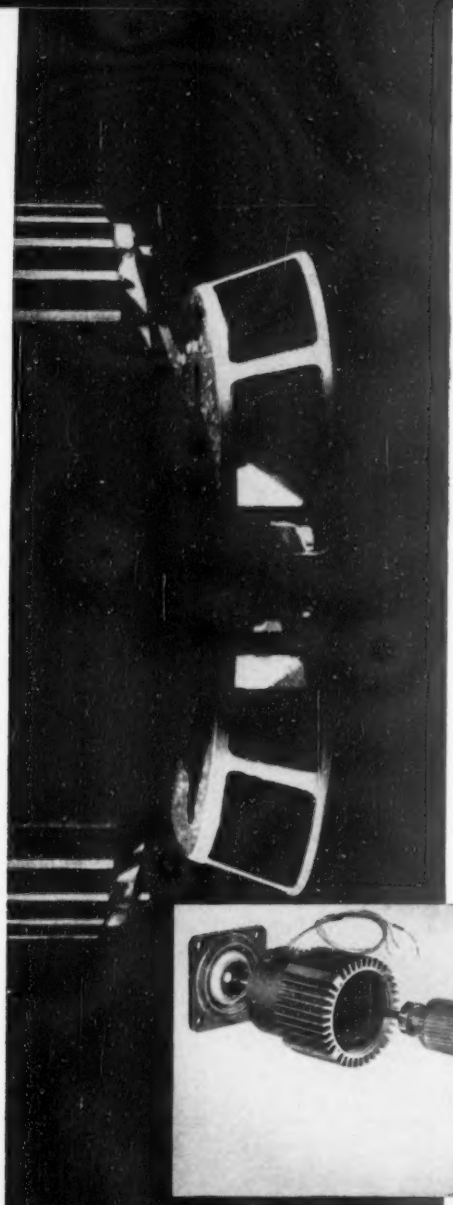
TOMORROW'S AIRCRAFT: *One step closer*

**NOW...an a-c motor that runs "cool," retains output at extreme altitudes**



Drive power you can depend on . . . that's the keynote of the new line of Westinghouse 400-cycle, a-c motors. They deliver from 1/30 hp to 3 hp continuously from sea level to 50,000 feet—and raise performance standards to new highs in reliability and efficiency.

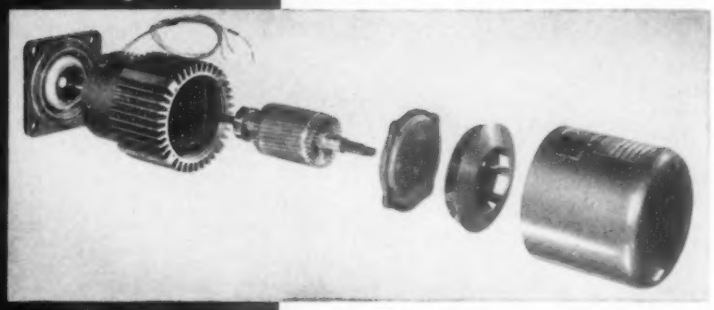
More horsepower than ever before has been packed into extremely small dimensions—like the four-inch diameter frame which delivers 3 hp and weighs under 10½ lbs. In spite of this small size and high rpm, temperature rise is kept exceptionally low by using new cooling techniques giving optimum thermal characteristics to produce the greatest possible horsepower per pound at *all altitudes*.

These new motors, designed to meet the requirements of specification MIL-M-7969, are totally enclosed, fan cooled and explosion-proof —ready-made for the most hazardous airborne applications. Sparks or flame caused by any abnormality cannot progress outside the motor. A patented method of flame suppression provides this same advantage on larger, open motors, over 3 hp.

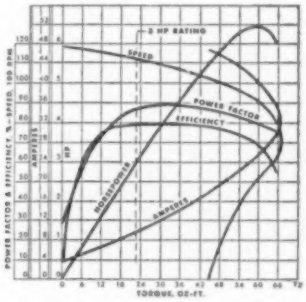
## Get More Information . . . NOW!

These new a-c motors—in ratings from 1/30 to 3 hp—are available NOW for direct drive and gear head applications. A drive you can depend on for vital controls and auxiliaries, they meet builder and user specifications with reserve to spare.

And Westinghouse will render full assistance in applying this new motor—the most advanced 400-cycle, a-c drive available today—to help you bring tomorrow's aircraft . . . One Step Closer. Get complete data and application information from your Westinghouse salesman or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-91016



The exclusive Westinghouse cooling design is built around an aluminum frame with integral fins. A new, efficient shrouded fan provides high volume cooling air flow. The rotor has extended conductor bars giving far more effective internal air circulation and cooling without added fan weight.




Performance curves for the 3-hp motor highlight the efficiency of these new a-c motors and their ability to handle loads from sea level to 50,000 feet. Greatly simplified and ruggedly designed, they handle even higher intermittent loads for temporary demands, especially at altitude.

**Jet Propulsion • Airborne Electronics • Aircraft Electrical Systems and Motors • Wind Tunnels to Plastics**

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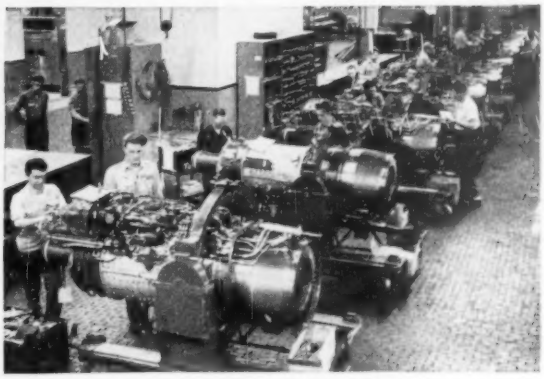
TOMORROW'S AIRCRAFT *One step closer*

# New headquarters for jet engine pioneering

Increased capability results from integration of all jet engine operations under one roof . . . making possible the close coordination typified by this exchange of ideas between Division Manager W. W. Smith, Chief Engineer A. Chilton, and General Works Manager S. S. Stine.

The new plant contains one of the country's largest and most complete Model Shop facilities. A complete factory in itself, it is the center of continuing development and product improvement. New ideas are taken from design layout to prototype stage and readied for performance testing.

Every production engine runs many hours at various power settings before final inspection and shipment. The 32 test cells permit a continuous schedule of development testing in addition to the required production engine performance checks. Every required test can be made.



Westinghouse turbojets are rolling off the production line at Kansas City. Manufacturing facilities include an 80-acre plant, production aisles a quarter-mile long, multiple processing lines and integrated flow systems—all directed toward mass production of jet engines. It is a completely self-contained factory, equipped for precision work.

There's a new headquarters for the Westinghouse Aviation Gas Turbine Division . . . at the rapidly expanding Kansas City plant of the Corporation. This headquarters means greater Westinghouse capability to serve the aviation industry and national defense.

First used as a production facility to meet increased demands for Westinghouse engines, this modern plant now houses all aviation gas turbine activities. Continuing expansion of research and development facilities makes it a completely integrated jet engine research, development and production center . . . the largest and most completely equipped in the world, and all under one roof.

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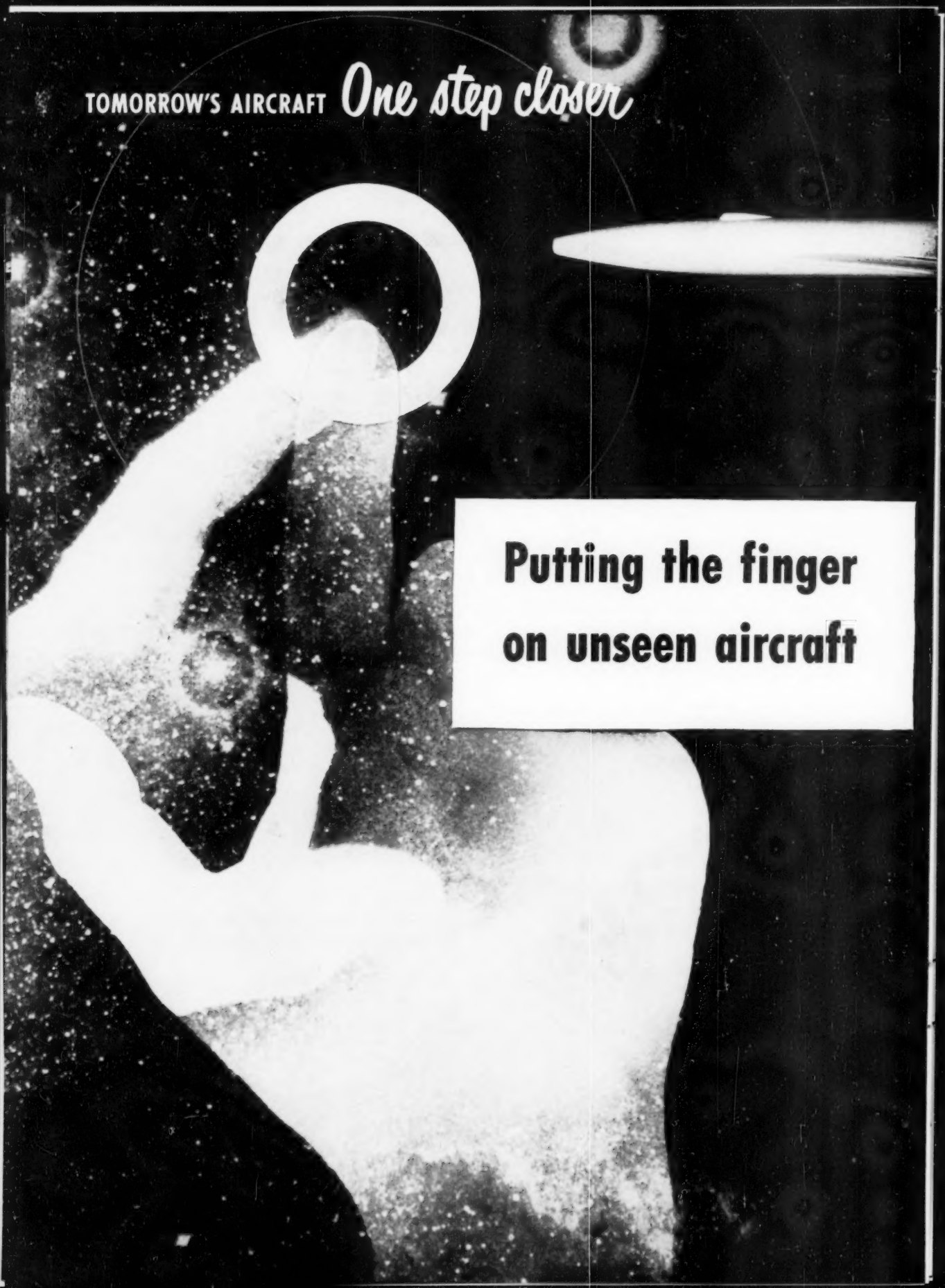
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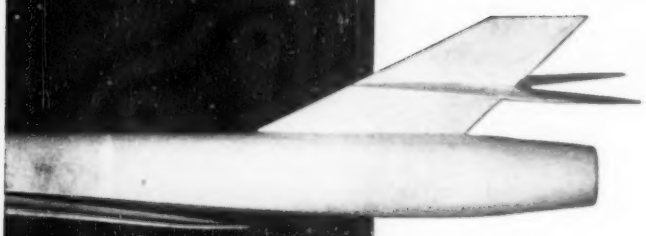
on unseen aircraft



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may develop preferences for a particular manufacturer's product. They may be convinced that they are acting in the best interest of the government. We learn of these complaints through letters from congressmen and USAF headquarters and from the companies direct.

Col. Robinson carefully checks each complaint and is in many cases able to obtain more favorable treatment after he has explained the case fully to the buyer concerned.

▶ **Pressure From Congress**—Handling of congressional inquiries, a top priority job in all government agencies, is another function of the Office that requires tactful, careful techniques.

Some congressional letters to government purchasing agencies follow this pattern: "I don't want to ask any special favors, but I would like the Blank-Blank Corp. to be given every consideration." AMC's reply is to advise the congressman that a low bid and a good product is still the best method of getting an Air Force contract.

Office of Inspection also arranges for the appearance of the proper witness before congressional committees, and sets up appointments with committee staff members visiting AMC for the purpose of obtaining information on its activities.

▶ **'Conflict of Interests'**—Manufacturers representatives are required to furnish affidavits to the Office of Inspection regarding former government service to insure compliance with the "conflict of interests" statute.

Department of Justice opinion states that the "statute prohibits any former employe of the federal government, for a period of two years after leaving government service, from representing any non-governmental interest in any matter whatsoever involving any subject matter directly connected with which such person was so employed or performed duty, in which the United States is interested, directly or indirectly, whether as a party, as an enforcement agent, or otherwise."

Key statement in AMC's affidavit form is: "My duties while in government service (did) (did not) relate to subject matter of the nature involved in my representation."

Attorney General Herbert Brownell recently asked Congress to strengthen the "conflict of interests" legislation by barring former employes from ever handling for private interests any government matter with which they were associated while government employes. He also asked that the penalty for violation of the statute be increased to two years in prison or $10,000 fine from one year in prison or $10,000.

▶ **Public Relations Angle**—Staff of the organization is composed of personnel with legal and investigative experience. "I consider good public relations the most important single thing in my operation," says Col. Robinson. He considers his background in Air Force public relations as an invaluable asset.

Robinson is a 34-year-old career officer who has headed the Office of Inspection for 18 months. He was born in Catonsville, Md., and was graduated from Western Maryland College in 1941. A member of the ROTC, he was immediately called to active duty and spent three years in the infantry before going to the Air Force navigators school. He served overseas in Italy with the 15th Air Force which, at that time, was commanded by Gen. Nathan Twining, present USAF Chief of Staff.

Returning to the U. S. in 1945, he was assigned to the Office of Information Service at USAF headquarters, and was integrated into the regular Air Force in 1946. He served six years in the public relations assignment before coming to AMC.

He holds strongly to the premise that this public relations experience was the best training he could have had for his present job.

Col. Robinson, after handling hundreds of cases involving gratuities, is still to have a personal experience in those matters. "No one," he says, "has ever tried to bribe me." ■ ■ ■

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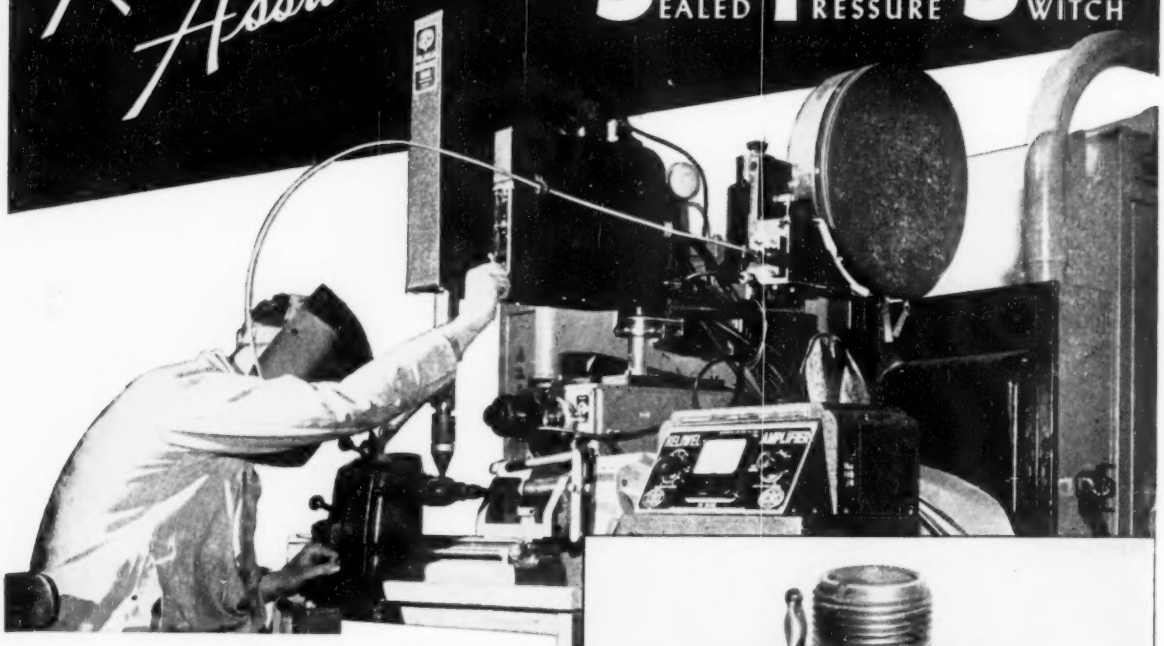

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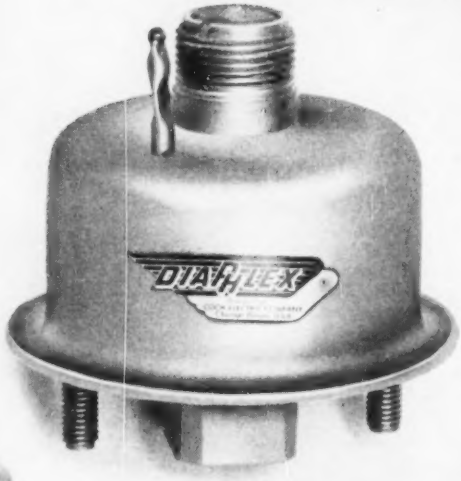


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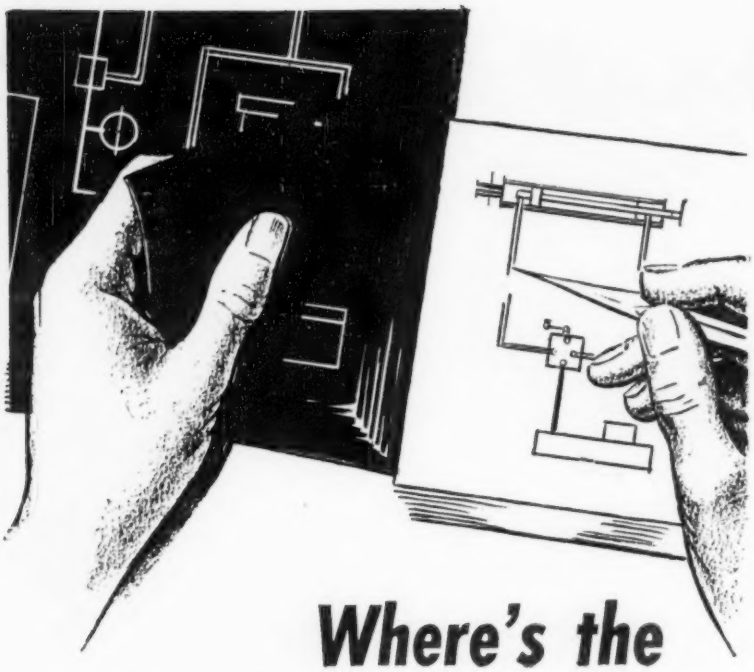

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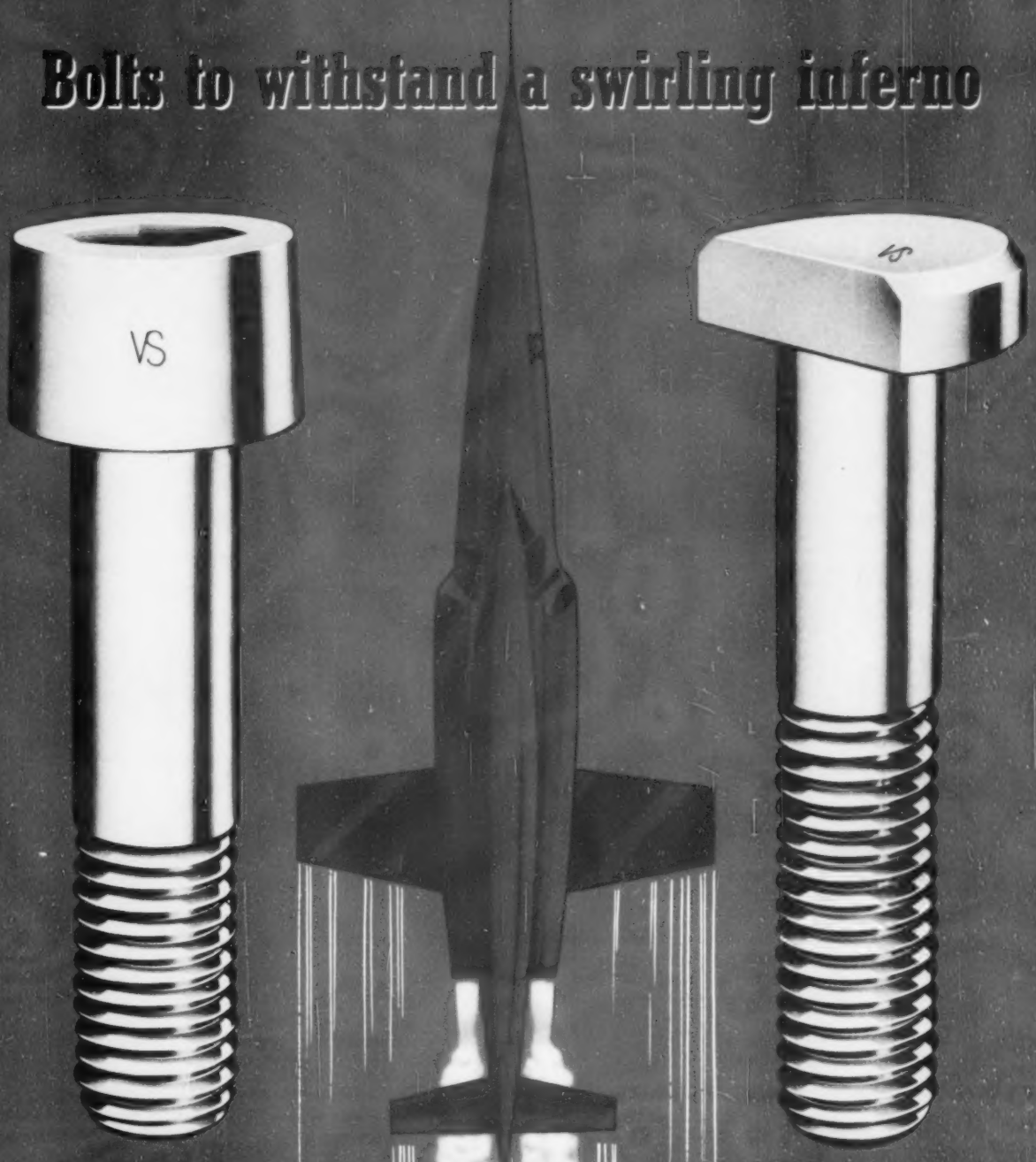


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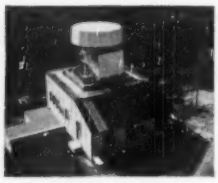

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# Logistics: Keeping the Pipelines Full

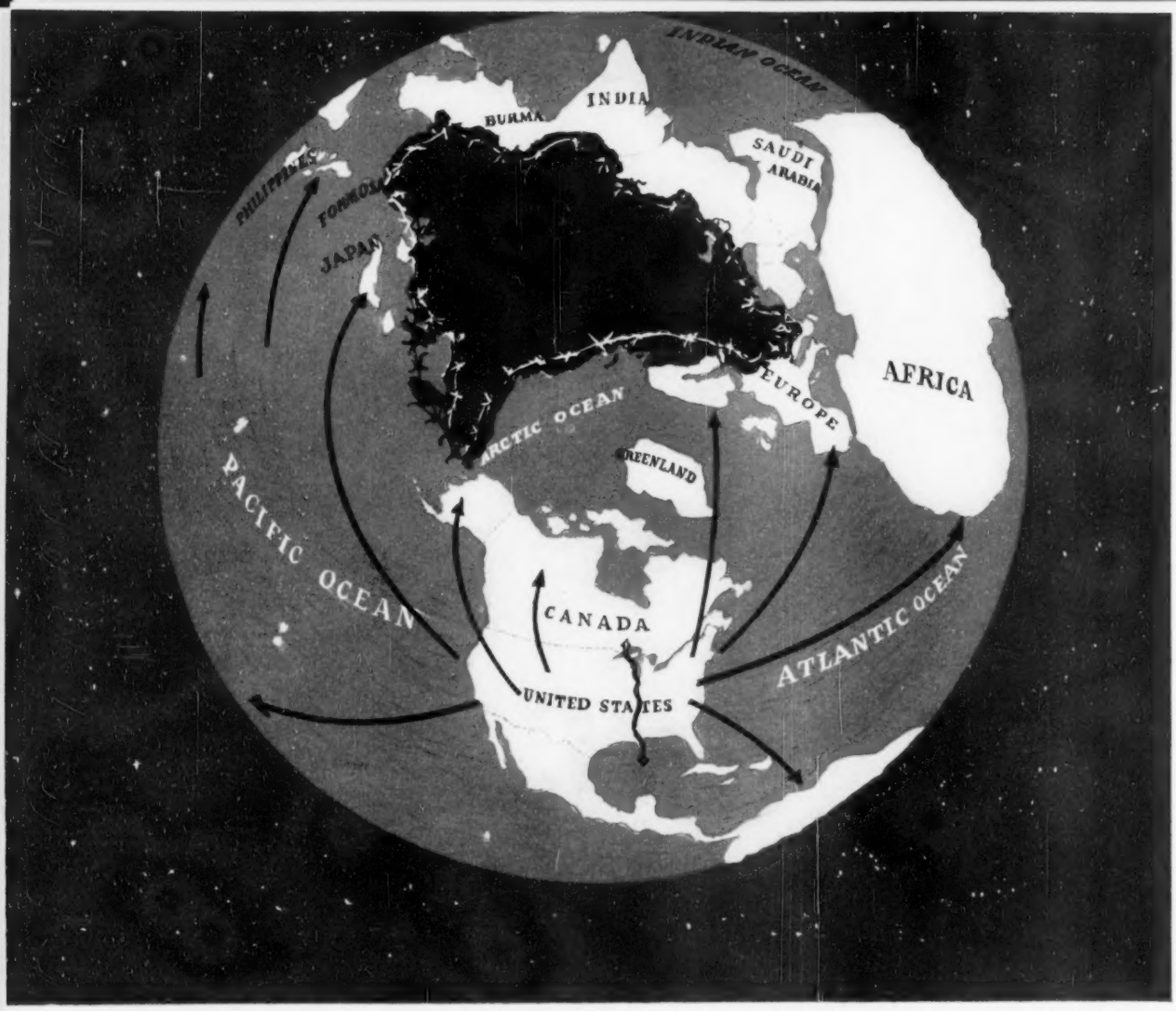
**Increasing efficiency of its global supply system is a critical task facing Air Materiel Command. In tackling this job, AMC is working against three strong trends:**

**• Rising Force Level. As USAF builds to 137 wings, AMC has to expand its supply system to meet the needs of a substantially larger Air Force.**

**• Global Deployment. USAF has combat units deployed in Europe Africa, Asia, and the Arctic. Longer supply lines require either more items to keep them filled or faster delivery methods.**

**• Increasing Complexity. USAF now requires AMC to handle 1¼ million different types of items. New items, mostly avionics, are coming into the supply system at the rate of 800 a day.**

**Because USAF now requires large portions of its combat strength to be maintained in a state of instant combat-readiness, AMC must provide logistical support at 100% level. Combat-ready forces must have everything they need all the time.**




**GLOBAL PIPELINES** of AMC's bi-zonal supply system require air transport for high-cost equipment to keep combat units combat ready.

# Airlift Helps AMC Cut Logistics Knots

**Air Materiel Command is looking toward increased use of airlift to help solve two knotty USAF logistical problems.**

**AMC believes that airlift tailored to meet specific logistical problems and organized with the best management and traffic control procedures of commercial airlines can do these things:**

It can maintain a higher percentage of USAF combat aircraft in a state of instant combat readiness by providing swift delivery of vital parts required to keep farflung combat units in prime operating condition.

It can effect major economies in the quantities required of high-cost USAF inventory items, such as jet engines, radar bombing systems, propellers, electronic gunsights, etc., by drastically cutting supply pipeline time and the number of such items necessary to keep a global pipeline full.

▶ **New Status**—USAF gave airlift a new status in its supply pipeline systems last April with the publication of Air Force Regulation 76-16, which recognizes air transportation as a normal rather than emergency method of transportation. It also establishes policy guidance encouraging USAF to increase practical use of air transport for regular shipment when economically sound instead of only for emergencies.

Says AFR 76-16: "Whenever the estimated combined cost of transportation, packaging, handling, and breakage by air shipment is less than the estimated cost by other means, air transportation will be used to the extent available."

"In AMC," says a logistics expert, "we are interpreting this policy to mean that the use of surface transportation for high-cost, critical or emergency-requisitioned items must be justified in each case. This is a reversal of the past policy that required full justification for the use of airlift."

▶ **Logistics Planning Section**—USAF and AMC have been experimenting with airlift applied to specific logistical problems and studying broad development of an aerial logistics system on a more intensive scale during the past two years.

In USAF headquarters, a special logistics planning section monitors this problem. Serving as special consultant to USAF Secretary Harold Talbott and the AMC on airlift problems is J. J. O'Donovan, formerly a vice president of Capital Airlines and a veteran of 27 years in air transportation.

Among the conclusions reached as a result of these experiments and studies:

• **Substantial savings can be made** through the use of economic and effective airlift by reduction in pipeline time and the resultant cuts in procurement requirements for high-cost equipment.

• **Enlarged airlift capacity** would augment the D-day capabilities of USAF.

• **AMC must have the nucleus** of a wartime airlift capability in being during peacetime. First step in this direction was establishment of the "Mercury" Service, linking all major AMC bases in the United States with five C-46 roundtrips weekly.

As a result of these conclusions, AMC air transport experts say, "We are continuing our efforts to establish valid peacetime requirements for the use of airlift within the USAF logistics system."

Since AMC's traditional concept of aerial logistics has been to use USAF-owned aircraft operated and maintained by reputable air carriers on a competitive-bid basis with high-scale daily utilization, it would appear that both scheduled and non-scheduled civil air carriers will be extremely interested in the progress toward new and permanent airlift requirements.

▶ **Spotlight on Engines**—AMC has focused its most intensive experiments and planning on airlift of aircraft engines, both piston and jet. Engines are perhaps the most critical items in the USAF supply system. This is why:

• They are getting to be fantastically expensive. A Pratt & Whitney J57 turbojet costs $250,000—about the same cost as a World War II P-51 fighter. USAF budget cannot afford stockpiling such expensive items in large quantities.

• They are both a production and overhaul bottleneck. Lack of swift delivery of engines to airframe plants slows deliveries of complete weapons systems to USAF combat units. Lack of swift movement between USAF combat units and AMC overhaul depots keeps too many engines out of service and too many aircraft out of commission. Under current surface pipelines one type of jet engine averages four months in service and seven months in transit and in the shop for each overhaul cycle.

• They are subject to a relatively high rate of obsolescence. If USAF had to buy quantities of new engines large enough to fill a surface pipeline (average 300-400 engines between U. S. and Korea), it would be stuck with large quantities of useless equipment when superior new models are ready.

▶ **Berlin Experience**—AMC got its first substantial experience with an aerial pipeline for engines during the Berlin airlift when the MATS squadron of Douglas C-74s shuttled plane loads of 20 P&WA R2000 piston engines each between the big C-54 maintenance depot at Burtonwood, England, and the AMC overhaul depot at San Antonio. Without this swift shuttle of engines the C-54 fleet supplying Berlin would have collapsed.

After the Korean war began, AMC started an experimental six-month engine shuttle with contractor-owned C-46s between the San Antonio overhaul depot and the overseas shipment point for Korea at Sacramento AMA headquarters. The contractors, AMC and USAF all made separate cost studies of this project. Cost averaged 10 cents a ton-mile.

Other experiments were conducted, shipping P&WA R4360 piston engines from the manufacturer's East Hartford, Conn., plant to Convair's B-36 assembly line in Ft. Worth. Slick Airways used its new DC-6A for this service, and later American Import and Export Co. took over with C-46s.

▶ **Project Skyway**—In the fall of 1952 Project Skyway was initiated as an engine airlift logistics experiment in moving R4360s from P&WA and AMC depots to Strategic Air Command B-36 wings in the field. When new or overhauled engines were delivered to the B-36 wings, old engines ready for repair were carried to the overhaul depots or P&WA factory on the backhaul.

The result of Project Skyway convinced USAF and AMC that use of an aerial pipeline for engines would:

• **Cut pipeline times** by one-third.

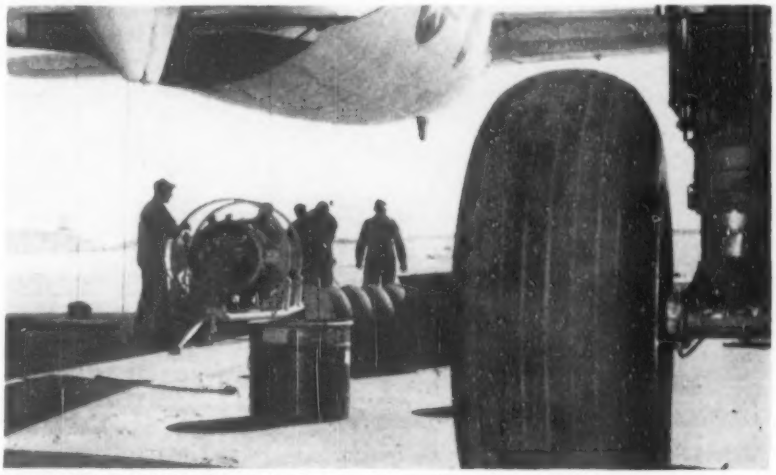
• **Substantially cut purchase** of engines to support any particular aircraft program.

• **Cut transportation costs** by using lightweight, inexpensive shipping cans (about 12% of engine weight) instead of the expensive and heavy steel cans.

• **Permit better management** control over high-cost items and allow tighter scheduling of overhauls by returning engines requiring repair to depots on the backhaul from delivering serviceable engines to combat units.

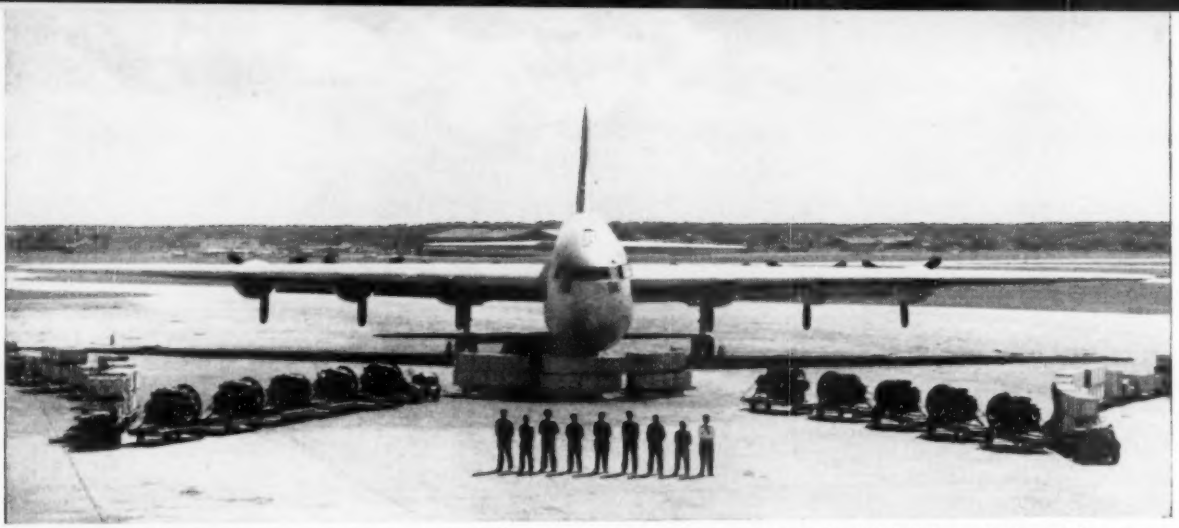
▶ **Skyway Lessons**—Major lessons learned from Skyway were:

• **Centralized traffic movement** and payload control is necessary. With these methods it is possible to average close to



**EFFICIENTLY MANAGED** airlift of expensive engines to combat units means . . .

**REDUCTION** in quantity of jets to fill surface transport pipelines.



**GIANT CONVAIR XC-99,** largest transport now in service has pioneered operational techniques for 100,000-lb. payloads over long range.

**FAIRCHILD C-119** swallows large cargo with ease, loaded from truck bed level.

**DOUGLAS C-124** supplies Arctic outposts that are isolated from surface pipeline



100% payload and costs of 10 cents a ton-mile for such operations.

• **Considerable refinement** in transport aircraft, inflight cargo-handling equipment and ground-handling equipment is necessary to cut pipeline time further.

As a result of Project Skyway, AMC is now making an air-transportability study of all its high-cost items.

"To make aerial logistics really pay," says an AMC air transport expert, "they must be operated under tight, efficient airline-type traffic movement. It's no good just to get airlift per se. High-cost airlift could soon consume all pipeline savings. You must have all the other techniques that go with it. You must identify the surface pipeline for each specific high-cost item and then chop away at it with airlift.

"For example, airlift is most economical when it provides door-to-door service between source and consumer. If you have to package a shipment for surface movement to the nearest airport, all of the economy from inexpensive, light, air-transportable packaging is lost.

"Although there are special logistic carrier aircraft under development for USAF, we don't have to wait for them to get an effective aerial logistics system. We can make an excellent beginning with the C-54 and C-46 aircraft that we already have available."

▶ **Mercury Service**—AMC took the first step in establishing a domestic aerial logistics system recently with the Mercury Service operated by two non-scheduled carriers with C-46s under a three-month contract.

AMC established the Mercury Service as an answer to the high cost of air transport for special cargo. An AMC survey indicated the command spent $150,000 monthly for commercial airfreight, air charters and air express.

An AMC air transport study estab-

Photo courtesy Trans-Canada Air Lines

# team up with HOBART power-pull for headline performance

**Hot or cold, rain or shine, the Hobart POWER-PULL gives you headline performance without delays. Yes, you can get most for your money with Hobart. You can do better and faster work and with complete protection to the electrical system of the airplane. Its controls are so simple that unskilled help can operate it easily.**

## LOOK WHAT YOU GET!

### SELF-PROPELLED UNIT

The new 871 POWER-PULL has standard clutch with four-speed standard gearshift, short wheelbase, wide front and rear treads, springs in front only for easier handling and steering, short turning radius, wide two-man seat and back cushion, hydraulic brakes, and head and tail lights. A high reserve of power in the Chrysler V-8 engine assures consistent operation.

### GROUND AUXILIARY POWER

The Hobart generator, close-coupled to the V-8 engine, is rated 28.5 volts, 1000 amperes, d.c. With line-drop compensation and an aircraft-type carbon-pile voltage regulator, the generator delivers constant voltage at the aircraft bus regardless of load. In addition, it provides these operational features: overload, overvoltage, reverse-current, and overspeed protection.

### CONTROLS and ACCESSORIES

In addition to standard automotive controls, the switchboard in front of the driver's seat includes everything necessary for the control of the generator. Extra features include: output cable with plug; Kidde Type 2½T carbon dioxide hand fire extinguisher; spot light that can be adjusted as a floodlight; clearance lights; reflectors; Sun Electric tachometer; engine-hour meter (your "watchdog" for oil changes, service, etc.); and rear coupler—all included in the original cost.

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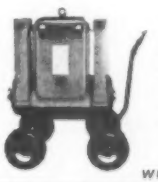

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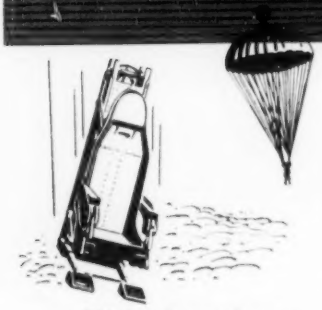

*This is only one of many examples of how Weber airgineering works . . . if you have a problem why not take advantage of Weber's design-to-delivery service?*

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lished the fact that it could operate a scheduled airfreight system between its depots and overseas shipment points for about half the cost of commercial rates.

The contract operation cost about 11 cents a ton-mile compared with about 25 cents a ton-mile for commercial airfreight.

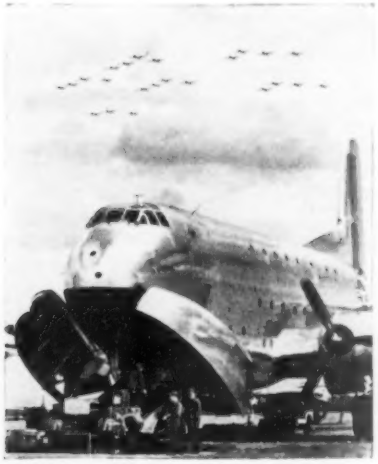
AMC originally intended to operate Mercury with USAF-owned aircraft on a competitive-bid basis by reputable air carriers. However, in the interest of time, AMC agreed with USAF to begin the service with carrier-owned C-46s. The western half of the service began last April and is operated by American Import and Export Co., Miami. The eastern service is flown by Capitol Airways, Nashville, and began June 1.

Mercury provides five C-46 round-trips (13,000-lb. payload) weekly between all of AMC's major depots and its aerial ports of embarkation, with the exception of the run between Hill AFB (Ogden) and McChord AFB (near Seattle) which gets only two trips a week. The service is flexible and can include major industrial areas where urgently needed parts are manufactured, when necessary.

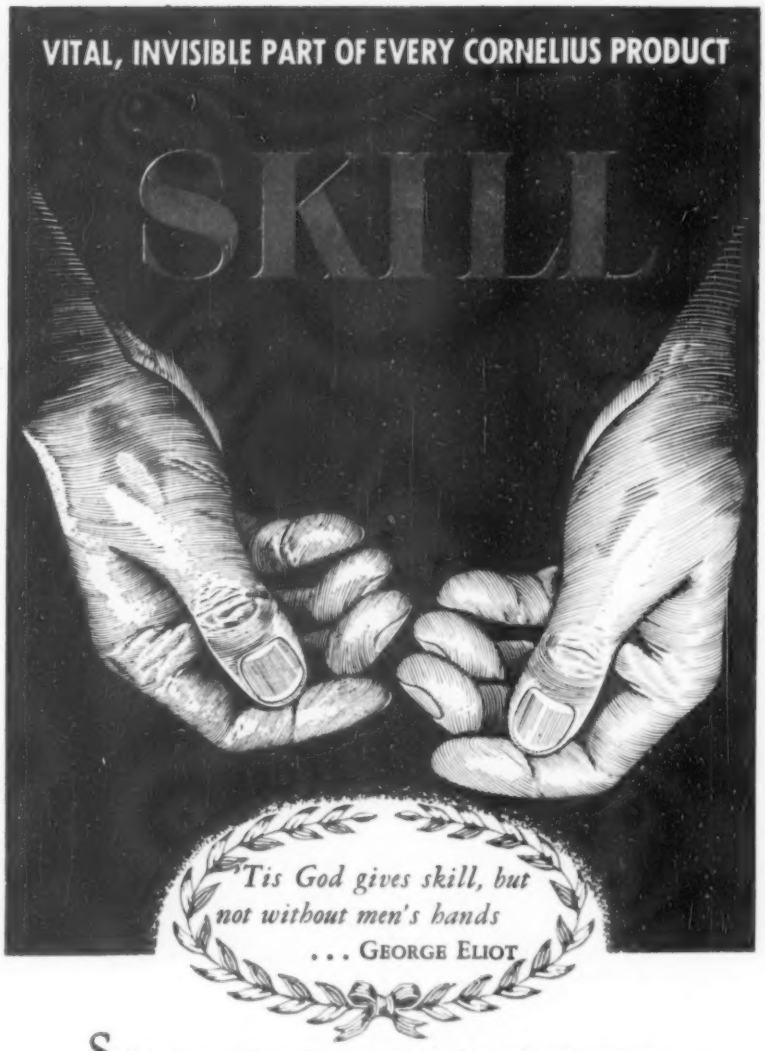
A feeder network of surface and air transportation has been developed to funnel high-priority cargo into Mercury Service via the depots. AMC headquarters establishes schedules and load allocations, manages the service and provides route supervision. AMC depot personnel handle Mercury cargo at each stop.

From Mercury, on its present modest scale, AMC hopes to get:

- **Definite information** on current and future requirements for airlift.
- **Faster pipeline time** on its high-cost items, critical parts, and parts needed



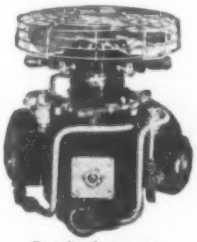
**GLOBEMASTER** unloads high-priority cargo in support of F-84 group in air.


Skill is the wedding of a man's mind with his hands. Chances are you will never see the skilled hands that manufacture Cornelius products . . . for they are many, of many skills. You will, however, see proof of their skilled talents in the reliable performance of every product that bears the name *Cornelius*.

The skill, of which we speak so proudly, is the kind that satisfies man's search for perfect craftsmanship. Vital, but unseen, it's yours in every Cornelius product.

Because it makes sense to seek skill...it makes sense to see Cornelius for information and assistance on any pneumatic problem. All our skill is ready to help *you*.



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PIONEERS IN THE DEVELOPMENT OF PNEUMATIC SYSTEMS FOR AIRCRAFT

*Typical pallet shipment of Torrington Needle Rollers showing two boxes of 20 cans each strapped to pallet. Open box of cans in foreground.*

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Torrington Needle Rollers deserve this special vacuum pack. They're precision rollers made under statistical quality controls of extraordinary rigor. Every step from alloy selection to polishing and packing is carefully checked to assure you that every can of rollers you receive meets your high standards. And to help you use these rollers to best advantage, Torrington's engineering staff is always available to assist in application design and testing.

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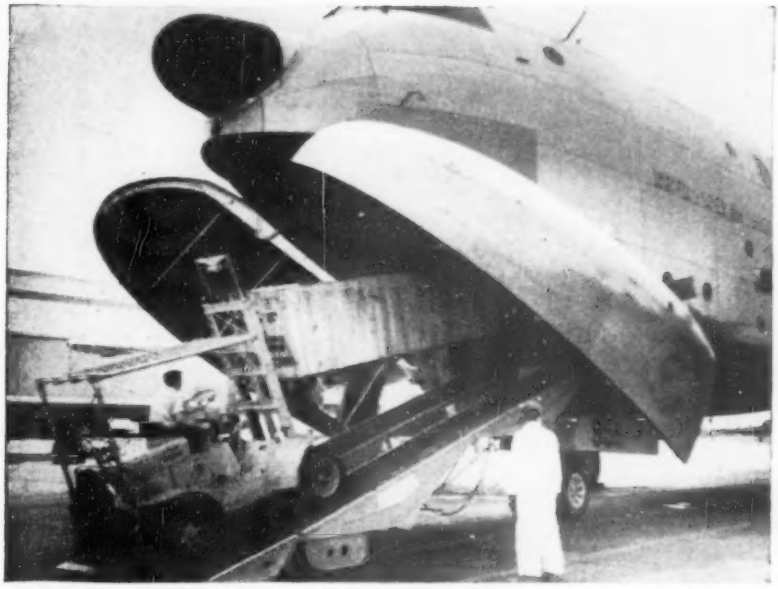

**HIGH-VALUE CARGO** loaded in C-124 to put grounded combat craft back in service.

to put grounded aircraft back into the air.

• **The nucleus of a dependable,** guaranteed, scheduled cargo airlift that will be trained and capable of expansion to meet D-day requirements.

► **Buying Airlift**—AMC now gets the bulk of its overseas airlift from MATS. However MATS can augment its capacity to meet specific requirements by contract with commercial carriers. These contracts are negotiated by AMC's Procurement Division.

However AMC also buys directly, through its Transport and Packaging Division, emergency air charters from commercial operators. These are usually one-shot affairs aimed at meeting a specific, unforeseen emergency, ranging from rushing critical parts from a subcontractor to an airframe plant to pushing badly needed supplies to an Arctic outpost or our French allies when they were fighting in Indochina.

AMC frankly buys the lowest-cost form of reliable air transport on these charters, as the Command sees its job clearly to buy its transport most economically.

► **Spanish Operation**—Establishment of an air materiel area in Spain to support USAF activities there will provide AMC another opportunity to develop its airlift capabilities and techniques. Since Spain is not part of the existing NATO logistical organization, USAF activities there will be supplied directly by AMC.

Here, for the first time, AMC can plan a logistical organization based overseas from the beginning. An integral

MERCURY SERVICE
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SELFRIDGE AFB, MT. CLEMENS, MICH.
WESTOVER AFB, CHICOPEE FALLS, MASS.
MIDDLETOWN, PA. OLMSTED AFB.
HILL AFB, OGDEN, UTAH.
O'HARE INT'L AIRPORT, CHICAGO
NEWARK AIR TRANS CONTROL DEPOT NEWARK, N.J.
McCLELLAN AFB, SACRAMENTO, CALIF.
WRIGHT-PATTERSON AFB, DAYTON, OHIO
NORTON AFB, SAN BERNARDINO, CALIF.
TINKER AFB, OKLAHOMA CITY, OKLA.
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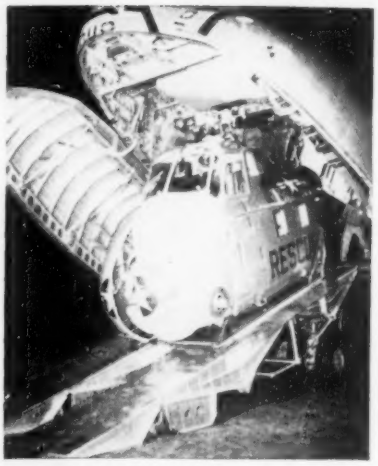


**RESCUE COPTER** is rushed to emergency duty in Douglas C-124 cargo transport.

part of its operation will be a drastically reduced pipeline, centrally controlled from AMC headquarters and using airlift of high-cost items to Spain as standard procedure with only low-cost items moving by sea.

Commenting on the proposed Spanish airlift one high-ranking AMC officer said:

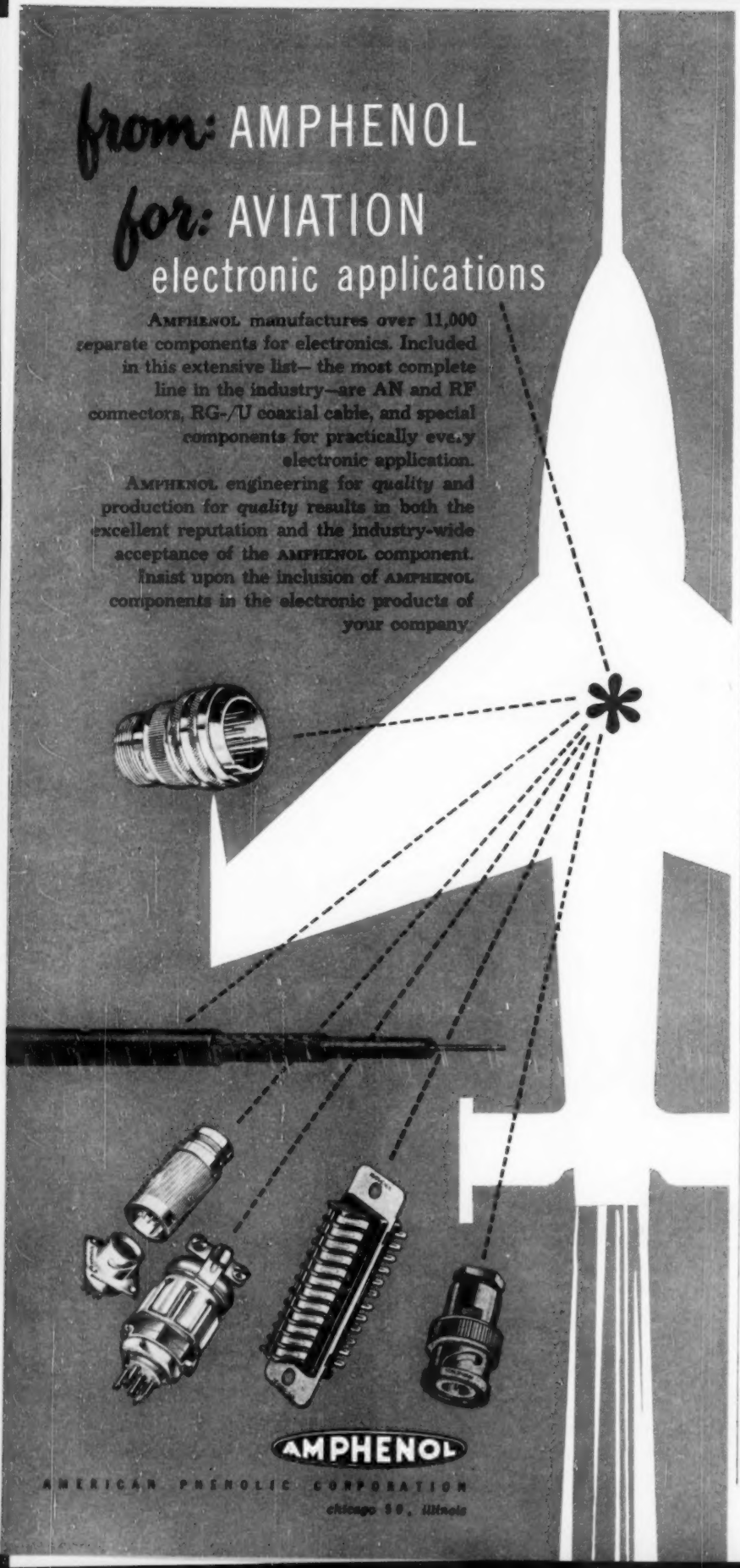
"Our past experience with airlift test programs gives us confidence that in the Spanish operation, logistical airlift of high-value items will graduate from an experimental concept into an economical reality."

▶ **XC-99 Accomplishments**—AMC also has been preparing for the future in the operation of huge logistic carrier-type of aircraft that USAF already has under development. These air transports of the not-so-distant future will have payload capacity of 100,000 lb. over trans-Atlantic range.

While AMC is prepared to establish its aerial pipeline with the C-46s and C-54s immediately available, it has been using the giant Convair XC-99 transport operated by the San Antonio AMA to accumulate operational experience and explore the problems of a truly heavy logistics carrier.

When the XC-99 was delivered to USAF in 1949 it generally was regarded as a white elephant with little utility. It was assigned to Kelly AFB, headquarters of the San Antonio AMA, in September 1950. There, Maj. Gen. Clements B. McMullen, then SAAMA commander, and a firm believer in aerial logistics, developed a program to use the XC-99 as a guinea pig in an operational evaluation program for heavy logistics carriers. This program was completed last month and showed the following achievements for the XC-99:

- **Logged 4,105 flying hours on 508 flights.**
- **Carried 36,537,141 lb. of United**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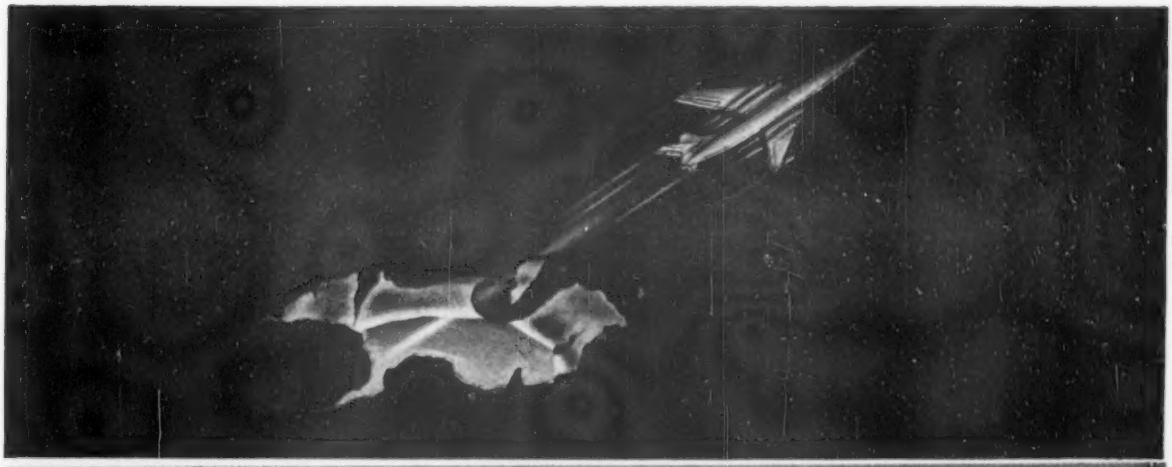
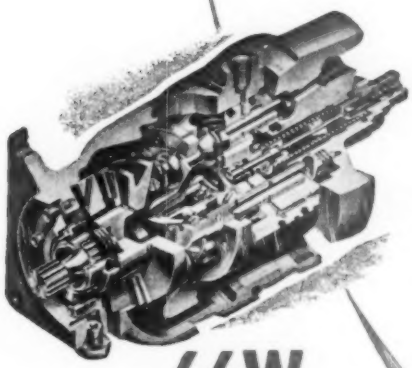


# STRATOPOWER Is Ready for the Planes Which Will Break Through Today's Ceilings

The modern STRATOPOWER Hydraulic Pumps are ready and able to perform efficiently well beyond heights penetrated by piloted aircraft. They've proved it! In Rockets, Guided Missiles and under the simulated conditions of the ionosphere STRATOPOWER Pumps *pump!* They are built to perform at full efficiency and with complete dependability under the extreme conditions and variables imposed by projected speeds and service ceilings.

STRATOPOWER Pumps draw fluid from unpressurized reservoirs to sustain system pressure at altitudes where other pumps, dependent upon pressurized reservoirs, would be unable to supply system demands. Thus, they afford that vital added safety factor for high altitude operation . . . system actuation is assured, even though reservoir pressure may be lost.



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*There is a STRATOPOWER Hydraulic Pump to provide the efficient source of fluid power for your requirement. Write for full information today.*

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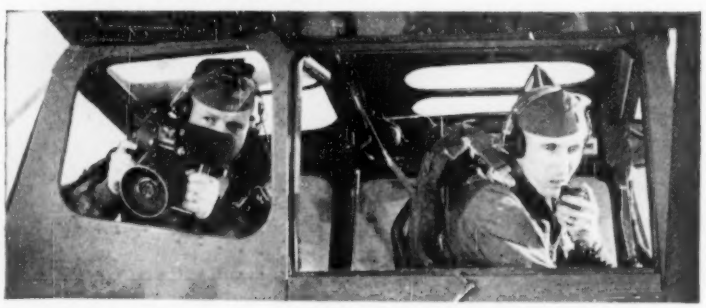
# *Their "Upstairs Eye" is a Cessna!*

Keeping U. S. artillery fire accurately, effectively "on target" is one of many vital jobs performed by sharp-eyed Army aviators. In training, these pilot-soldiers not only learn flying. They receive instruction in *all* military branches—Infantry, Medical, Transportation, Armored, Communications and Engineering, as well as Artillery. And to handle a variety of military jobs expertly, they need an airplane *as versatile as their training!* That's why many of these men are assigned to Cessna L-19 "Bird Dogs." Combat-proved L-19's can take it! They're easy to fly, easy to service, powerful and dependable. Today, Cessna is building L-19's in quantity for U. S. Armed Forces.

## Hard to Hide from Here



Aerial photographs, properly interpreted, reveal even the most expertly camouflaged men, equipment and installations. Offering excellent high-wing visibility, slow-flight characteristics and 213 horsepower performance, Cessna L-19's are frequently chosen for important photo reconnaissance missions. They carry enough radio equipment to contact ground *and air* units, are invaluable for directing both infantry and artillery fire.

## When Quick Answers Count

Fresh, accurate information, the first need of every field commander, is quickly supplied by Army observers flying Cessna L-19's. These highly maneuverable airplanes operate in and out of short, rough fields close to the action, are also valuable for wire laying, emergency equipment supply, courier trips, controlling military highway traffic, even evacuating the wounded.

Cessna
AIRCRAFT COMPANY

CESSNA AIRCRAFT COMPANY, WICHITA, KANSAS

States Air Force cargo.

• **Reached a low of 11.2 cents per ton-mile operating cost.**

During this period, the XC-99 demonstrated many feats of operational feasibility for a big transport. It landed fully loaded on a 5,400-ft. runway at McChord AFB and took off with a 104,000-lb. payload from a runway at 5,000-ft. altitude. On one of its trips it hauled the complete ground equipment of a fighter wing (98,801 lb.) 2,330 mi. nonstop across the continent.

It operates mostly semi-weekly 3,000-mi. roundtrips between Kelly and McClellan AFB at Sacramento, with a run from Kelly to Ramey AFB in Puerto Rico twice monthly. During fiscal 1953 the XC-99 flew 1,500 hours on 200 flights covering 11¼ million ton-miles at an average cost of 13.12 cents per ton-mile. Direct maintenance costs were 2.32 cents per ton-mile.

▶**XC-99 Modifications**—In July 1951 the XC-99 underwent extensive modifications to incorporate the result of experience gained during its initial operations. New R4360-53 engines with power ratings of 3800 hp. were installed, landing gear was strengthened, an integral loading elevator and self-traversing system for upper deck hoists were added to facilitate cargo handling.

Pre-loaded cargo bins were developed to fit the XC-99's upper deck, leaving the larger cubage free for cargo such as jeeps, aircraft engines, etc. Experience with the pre-loaded bins has been so successful that it is estimated that a 100,000-lb. payload transport originally designed to use the bins could be fully loaded in 30 minutes.

▶**For the Future**—Out of all these AMC-USAF experiments and studies probing the possibilities of aerial logistics it appears safe to predict the following future trends:

• **More application of cargo** airlift as a routine method of USAF supply.

• **Increasing use of USAF-owned** transports at a high daily rate or utilization. Manned by civil air carrier crews to provide a permanent augmentation of USAF cargo airlift.

• **More efficient use** of military air transport resources now available.

• **Reduction of procurement** on high-cost aircraft equipment, because of better utilization on smaller quantities through aerial pipeline and tight inventory control.

• **Development of bigger** and more efficient air transports, and both aerial and ground-handling equipment for air-transportable cargo.

These trends will mean faster and more efficient support for USAF's far-flung combat units and another step toward the realization of "more Air Force per dollar" through the reductions made possible in procurement of critical high-cost equipment. ■ ■ ■


# Quick facts on aircraft cleaning

## The Wyandotte products listed below will:

**1** Improve maintenance cleaning **2** Speed up production

### AIRCRAFT MANUFACTURE

| | PROBLEM | ANSWER | DESCRIPTION |
|---|---|---|---|
| 1 | Aluminum cleaning | Altrex* | All-purpose, non-etching soak-tank cleaner; removes marking inks and soil. |
| 2 | Deoxidizing aluminum prior to spot welding | 2487 | Room-temperature deoxidizer: reduces contact resistance of aluminum alloys. |
| 3 | Magnesium cleaning | W.I.G.* | Heavy-duty soak cleaner for magnesium, steel, copper and brass. |
| 4 | Removing heat-treat scale from stainless steel; brightening heat-treated aluminum | MF Acid | Replaces dangerous hydrofluoric acid: easier and safer to handle and use; less corrosive. |
| 5 | Paint-booth coating | Hedral | Protective coating. Cuts labor costs, simplifies booth upkeep. Brush or spray on. |
| 6 | Waterwash paint-booth compound | Flote | Very small amounts required; kills zinc chromate primer, floats air-dry lacquers. |
| 7 | Electrocleaning | F.S.* | Heavy-duty electrocleaner for cleaning steel before plating. Exceptional detergency. |
| 8 | Barrel finishing | Burnek | Add to water in barrel finishing for brighter metal finishes. Removes light tarnish. |
| 9 | Floor absorbent (anti-slip) | Zorball | An all-purpose floor absorbent; makes floors skidproof, safe at lowest use-cost. |

### MODIFICATION AND MAINTENANCE

| | | | |
|---|---|---|---|
| 10 | Steam cleaning | Altrex | Cuts scale formation; removes all types of soil from aircraft exteriors, decks, engines. |
| 11 | Emulsion cleaning | 1-2364 | Meets USAF Specification 20015-E and MIL-C-7122 (Aer). Will not craze plastics. |
| 12 | Carbon removing | P-1075 | Nonflammable, noncorrosive cold-tank carbon remover for jet- and piston-engine parts. |
| 13 | Integral fuel-tank desealing | 2789 | A "universal" desealant for removing all types of sealing compounds. Nonflammable. |
| 14 | Removing exhaust stains | *20 | Removes stubborn exhaust stains; prevents corrosion in exhaust-stained areas. |
| 15 | Washing aircraft exteriors | Aerowash LR231 | An excellent emulsion cleaner for regular aircraft maintenance. |
| 16 | Paint removing | Sprazee | Aircraft paint remover. Meets Specification AF-14119-C. |
| 17 | Engine test-cell cleaning | El-Bee* | An all-soluble cleaner for removing dirt, oil and grease from concrete surfaces. |
| 18 | Washing-machine cleaning | 397 | A special low-foaming, non-etching aluminum cleaner. Meets Specification MIL-C-5543. |
| 19 | Aluminum brightening | Alutone* | Brightener for exterior aircraft surfaces. Cleans and brightens in a single operation. |

*REG. U.S. PAT. OFF.

**For information,** circle the number on the coupon for each problem you're interested in. We'll send FREE DATA. *Wyandotte Chemicals Corp., Wyandotte, Michigan. Also Los Nietos, California.*

Wyandotte CHEMICALS

Wyandotte Chemicals Corporation
AIRCRAFT DEPARTMENT
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Please send information on the problems whose numbers I have circled.

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11 12 13 14 15 16 17 18 19

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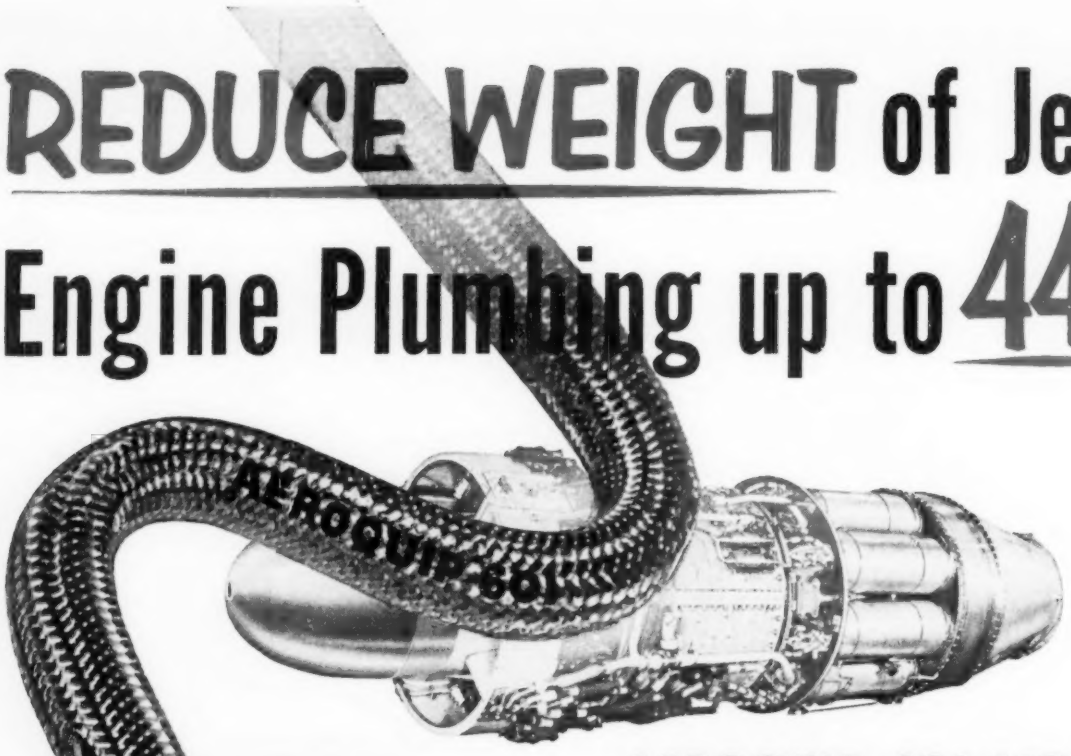
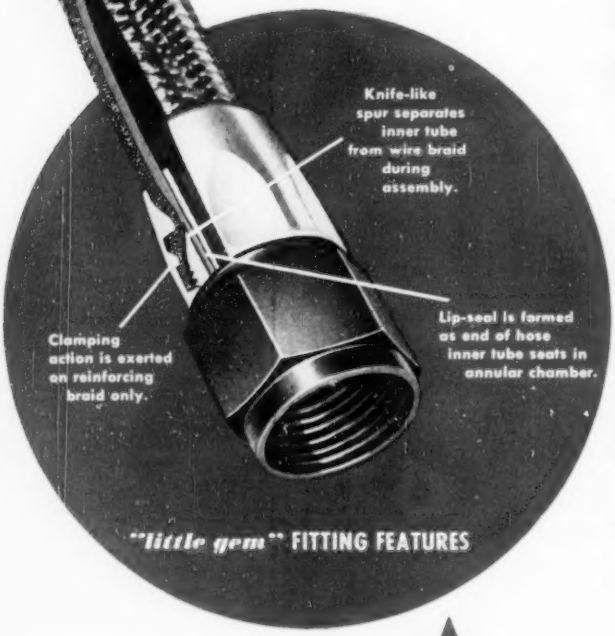
# REDUCE WEIGHT of Jet Engine Plumbing up to 44%





Knife-like spur separates inner tube from wire braid during assembly.
Clamping action is exerted on reinforcing braid only.
Lip-seal is formed at end of hose inner tube seats in annular chamber.
"little gem" FITTING FEATURES

## AEROQUIP 601 LIGHT-WEIGHT ENGINE HOSE

**WITH DETACHABLE, REUSABLE *"little gem"* FITTINGS**

● **UP TO 44% LIGHTER** than MIL-H-5511 . . . Aeroquip 601 engine hose features new thin-wall construction. Aeroquip ***"little gem"*** fittings provide additional weight savings.

● **UP TO 41% MORE FLEXIBLE** than MIL-H-5511 . . . Aeroquip 601 engine hose has a full cover stainless steel wire braid outer cover over a reinforced Buna-N inner tube. This allows tighter bend radius, reduces hose length, saves installation time.

● **UP TO 33% SMALLER O.D.** than MIL-H-5511 . . . Aeroquip 601 engine hose requires no cotton cover. Write for Bulletin AEB-3.

***"little gem"*** is an Aeroquip trade mark

Aeroquip

REG. TRADE MARK

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**AERO-COUPLING CORPORATION, BURBANK, CALIFORNIA**
***(A Subsidiary of Aeroquip Corporation)***

**Manufacturers of Aeroquip Flexible Hose Lines with detachable, reusable Fittings; Self-Sealing Couplings; Brazed Aluminum Elbows**
LOCAL REPRESENTATIVES IN PRINCIPAL CITIES IN U.S.A. AND ABROAD • AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

# How AMC Fills Overseas Lifelines

A ship plowing through the heavy swells off Gibraltar . . . a transport plane winging between Oahu and Wake . . . a truck rolling down a dusty road in Indochina . . .

All of these are part of the lifelines through which Air Force supplies flow overseas to USAF units or Allied countries of the Mutual Defense Assistance Pact (MDAP).

▶ **Port Controls**—Astride these lifelines, keeping the channels flowing from the U. S. to overseas depots, are four offices of the Air Materiel Command. These are the Overseas Logistical Control Agencies, located at Newark, New Orleans, Ogden and Sacramento.

Newark serves the Northeast Air Command and the air materiel force in Europe with its huge depots at Burtonwood, England; Chateauroux, France, and Erding, Germany. Sacramento serves Far East Air Forces logistics force with its bases in Japan and Okinawa. Ogden is the funnel through which the pipeline to Alaska flows. Supplies destined for Caribbean or South American USAF activities flow through the Mobile Air Materiel Area and the port of New Orleans.

## Overseas Funnels

These offices are charged with the important and often formidable task of acting as agents in the Zone of Interior (ZI) for overseas commands.

USAF commands operating outside the U. S. funnel their supply requisitions through one of these four agencies. It is then the responsibility of the control agency to order the supplies from the proper depot and arrange transportation to the command which ordered the supplies.

▶ **Huge Task**—The fact that there are some 300,000 separate items in the supply channels to the Far East, for instance, emphasizes the magnitude of the task. The Overseas Logistical Control Agency (formerly the Overseas Shipment Control Depot) must maintain positive control of each of these.

"Without IBM machines, we could not operate this system," says Ralph J. Greiner, deputy chief of the office at Sacramento. The office is headed by Maj. J. H. Taylor.

The system is based on a standard set of supply codes and is known as the case and item control system for overseas support.

▶ **How It Works**—It operates in this manner: The overseas depot, which might be the Far East Logistic Command in the case of Sacramento, transmits its requisitions to the Overseas Logistic Control Agency by radio. All requisitions are transmitted by radio, with the exception of stock replenishment items which are requisitioned by airmail.

The depot then determines the supply source in the U. S. for the item requested. The item might be one available in the Sacramento depot, it might be from another AMC depot, or in some cases it might be from an Army or Navy depot.

The control agency then directs the item to be shipped to the command which requested it. The agency decides whether the shipment is to be by air or surface.

On top-priority items, the supplier must begin supply action within 10 days. On stock replenishment items, the action must begin within 35 days.

If it is necessary to order the item from the manufacturer, the overseas depot is informed of the date when it is expected to arrive. If it is needed sooner, the requisitioning command can ask the control agency to speed the delivery date.

▶ **Shipping Flexibility**—The system enables AMC to delay until the last minute the decision on whether to ship by air, or water, thereby giving the logistics system the flexibility necessary to meet emergency demands. Every overseas destination is on an air logistics channel. Each command has a certain amount of airlift allotted each month by the chief of transportation to the theater commander. This is in terms of pounds available to the command on Military Air Transport Service (MATS).

The command then re-delegates this airlift to its Overseas Logistic Control Agency. Through constant telecommunication with the overseas command, the control agency is advised of the daily needs of that command.

When a supply source is ready to ship a requested item or items out to the command, it then asks the control agency for air authorization. Only at this moment is the final decision made on whether to ship by air or surface. Thus the decision can be based on:

- **The need of the command** at that moment—which might differ from its need of a week before.
- **The amount of allocated air space** remaining for that command.

If the decision is to ship by air, the case then is space-blocked for the entire trip from the supply point in the ZI to the requisitioning command.

Within the U. S., a contract airlift which connects all major depots to the APOEs provides a domestic airlift linked to the overseas lift.

Due to the close timing of this system, any decision to divert a shipment to water is made at the time when it is being packaged, thereby eliminating the cost of later repackaging.

A special code number is assigned each case when it is packaged.

## Close Control

Through its complex IBM coding system, the control agency is then kept informed of every pound en route to its aerial port of embarkation (APOE), every pound on hand at the APOE and every pound already shipped. Thus, it knows the net balance of air transport left for each command for the month.

▶ **Follow Through**—The control agency keeps the overseas depot informed of the progress of each requisitioned item, as for instance, the date when it moved from the supply depot to the APOE.

The APOE or port of embarkation (POE) advises the control agency when the case has been shipped and its estimated time of arrival at the overseas destination. This information likewise is passed along to the overseas command.

In the event a ship or plane is lost to enemy action or other causes, the logistical control office knows exactly what was on it and can quickly reorder the supplies.

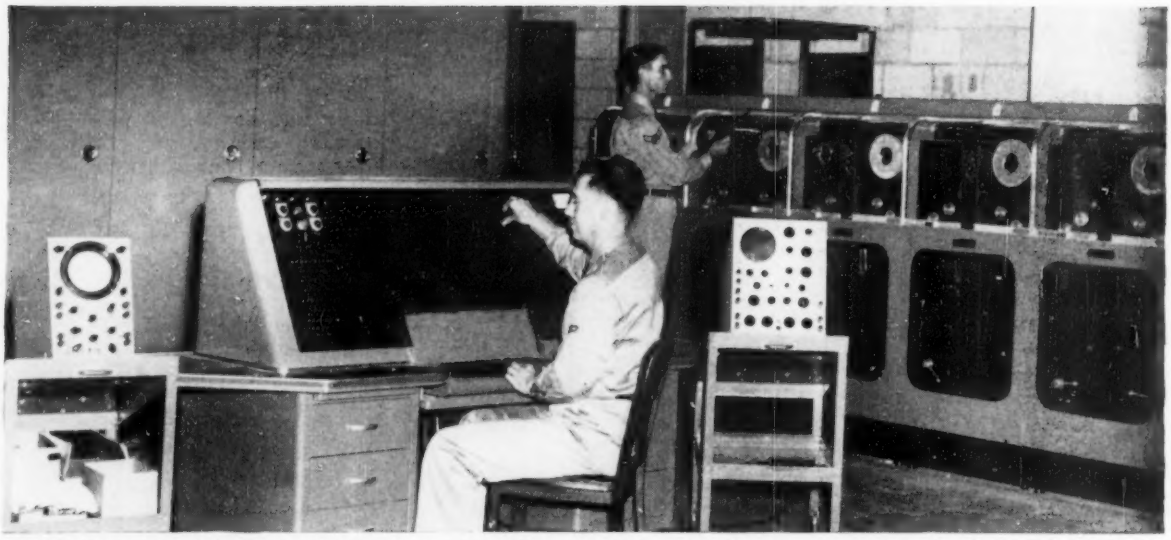
Due to the close control, the logistics office can accelerate or decelerate items in the supply channels as needed. If weather or mechanical failures should ground aircraft at an APOE, thereby piling up cargo at the aerial port, it can shut off further flow until the trouble is cleared up. It can then leapfrog higher priority cargo ahead of the stored supplies if necessary.

Such positive item control makes it obvious why IBM equipment provides the backbone of the operation. It would be an impossible operation manually, requiring acres of files.

▶ **New Aircraft**—Where pre-positioning of supply support is required, as in assignment of a new type of aircraft to a theater, the depot with the prime weapon responsibility determines the amount of spares necessary for the initial 90 days of operation.

After this, that package request—what those 50 or so aircraft need for 90 days—is given to the Overseas Logistical Control Agency responsible for that area.

From there on the process of ordering and shipping is the same as though the request came from the overseas command to which the aircraft are being assigned . ■ ■ ■



**LARGE DIGITAL COMPUTERS,** like this Remington Rand Univac installed at Air Materiel Command headquarters, will enable . . .

# Electronics to Streamline AF Logistics

**Electronics, which has revolutionized aerial warefare during the past decade, appears destined to do the same for Air Force management, logistics, and supply during the coming decade.**

**The Air Materiel Command is turning to electronic digital computers and data process machines to boost its operating economy, efficiency, and to speed the flow of supplies to hundreds of far-flung bases.**

AMC is pioneering the application of electrodata machines to the "world's largest department store and mail order house" (except possibly for sister military services). Compared with a large department store, which may stock 200,000 different items, or the Sears' catalog which lists 100,000 (considering a range of sizes as one item), AMC handles approximately 1,200,000 different items. Industry and business, particularly in the retailing field, are watching the electrodata system trail which AMC is blazing for application to their similar problems.

## 'Paper Mountains'

Today, approximately 80% of the total time involved in obtaining supplies is consumed in filling out, handling, and transmitting paper work, according to Maj. Gen. Phillips W. Smith, AMC comptroller. Only 20% goes into the actual moving of supplies. At present, AMC must anticipate procurement requirements for more than a million different items years in advance of the time they will be needed, using consumption data which is frequently months old.

▶ **Instant Service**—Electrodata machines will change this. Probably within the next decade, a supply officer at some remote base will enter his requisition by punching buttons on a device resembling a small adding machine. The order will be instantly transmitted electrically and routed to the proper depot, possibly thousands of miles away, which handles such supplies.

The requisition may then be transmitted, again automatically, to an appropriate section of the depot warehouse where another machine will print out the information, including even the necessary shipping label. Within minutes after the supply officer has punched out his order, half a world away, the requested material may be on its way to the depot's shipping department.

Except for material handling, the entire transaction will have been completed without human intrusion and delay, without reams of paper work. Wherever permanent records of the transaction are needed, machines will print or store them, automatically.

▶ **Automatic Inventory Control**—When a requisition is received at a depot's electrodata center, it will be checked automatically against available stock of the item—inventory records probably will be stored on magnetic drums or tapes. Based on the manufacturer's procurement lead time for the item, the number of items in stock at this and other depots, and the current rate of consumption, the machines will determine when the item should be reordered from its manufacturer.

This automatic inventory control will be able to provide depot procurement personnel with daily lists of items which need to be re-ordered, together with the estimated quantity needed for, say, the next three-month period, based on present consumption rates.

Initial planning for a world-wide electrodata supply system is already under way at AMC. The Logistical Systems Research and Planning group, headed by Col. G. C. McDowell, is working closely with logistics personnel of the Rand Corp., and with electrodata and business machines manufacturers. By this fall, the group hopes to have a program timetable ready.

▶ **Computers Already in Use**—AMC is not sitting back and waiting for its long-range world-wide system. The command is already using large electronic computers, including a new Remington Rand Univac recently installed at AMC headquarters, to solve complex budgetary, maintenance, and management control problems.

For instance, the Fiscal '56 budget estimate for airborne equipment spare parts, involving possibly half a million items, was computed in one day on a Univac, from individual depot figures. The same problem had formerly taken several weeks to solve using punch-card machines. (An additional three man-months were required to program the problem for Univac solution, roughly the same programming time required for punch-card machine solution.)

Another computation, to determine the product of flying hours and horsepower for all USAF aircraft, was completed in 21 minutes on a Univac. Using punch-card machines, the problem would have required seven machine-

Remington Rand

# BETTER BUSINESS METHODS

For Greater Profits Through Lower Costs

## Efficient and Inexpensive Purchase Order Follow-Up Clicks at Libby-Owens-Ford

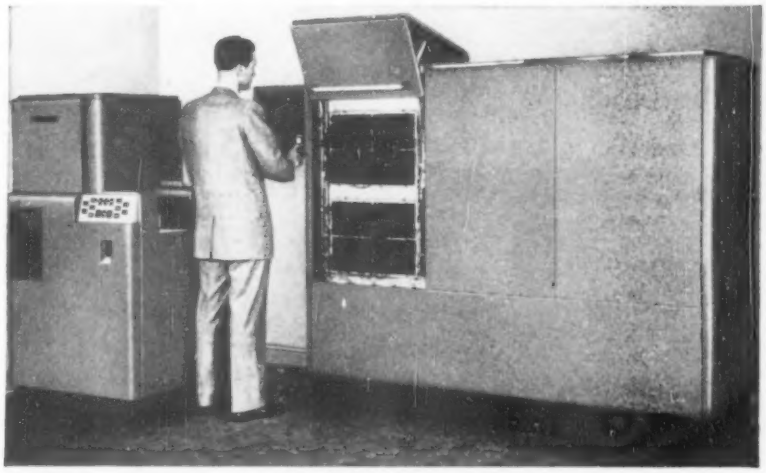
This Company processes open purchase orders with a minimum of confusion, executive time and expense, by using signalled Visible Tip Follow-Up Folders with printed date scales. All orders are followed up automatically by clerks on signalled

dates. Folders are filed by vendor's name for easy reference, yet the visible signals make follow-up easy. Kardlok signals lock into position for positive control, yet can be changed easily. The same folders are used hundreds of times and the same clerk handles a given order for its entire "open" life. This system covers any application where follow-up is essential. See LBV567 Rev. 1.

## Sound Maintenance Plan Slashes Costs; Assures Equipment Productivity

Folder X1383 Rev. 1 describes graphically a Maintenance Control System that is currently cutting maintenance costs while boosting equipment productivity in many well known plants. This Plan fulfills

the five *must* requirements of **any** workable maintenance control system, including *written work orders, scheduled work, equipment records, stores control* and *executive reports.* Read about it in X1383 Rev. 1.



## How an Aircraft Manufacturer Completes a Payroll for 16,000 Employees in 2 Days

This Punched-Card Electronic Computer is the key to the high-speed payroll operation enjoyed by a leader in the aircraft industry. It makes all computations to produce payroll register cards, and check-writing cards, with complete figures for the weekly gross pay, net pay and taxes... as well as to-date figures for gross pay, Federal and State taxes and controls on taxable and non-taxable wages.

The payroll register and payroll checks are simultaneously processed, on separate tabulators, to complete the entire job in two working days, with time to spare.

This Electronic Computer delivers comparable performance when handling the mathematics of production control, solving equations in aerodynamics, or preparing cost analyses.

These are only a few of the profit-boosting uses that leading aircraft manufacturers are finding for the Remington Rand 409 Electronic Computer. For more detailed information on how to apply this equipment to your own computing problems, circle COMPUTER on the coupon.

## New Printing Calculator is Fully Automatic

For figuring costs, prorating overhead, and for many other figurework chores, plant after plant is turning to the new, fully automatic Model 99 *Printing* Calculator. This "2-in-1" figuring phenomenon features automatic division and multiplication, plus 10-key touch addition and subtraction, with all proof printed on Simpla-tape in black and standout red. Printed tape proof and 10-key touch method operation assure greater, more accurate output. Get all the facts on this newest step in figurework progress from folder C669, offered in the coupon.

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*Yes, I'd like to have the literature circled.*

COMPUTER LBV567 Rev. 1
X1383 Rev. 1 C669

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Company _____

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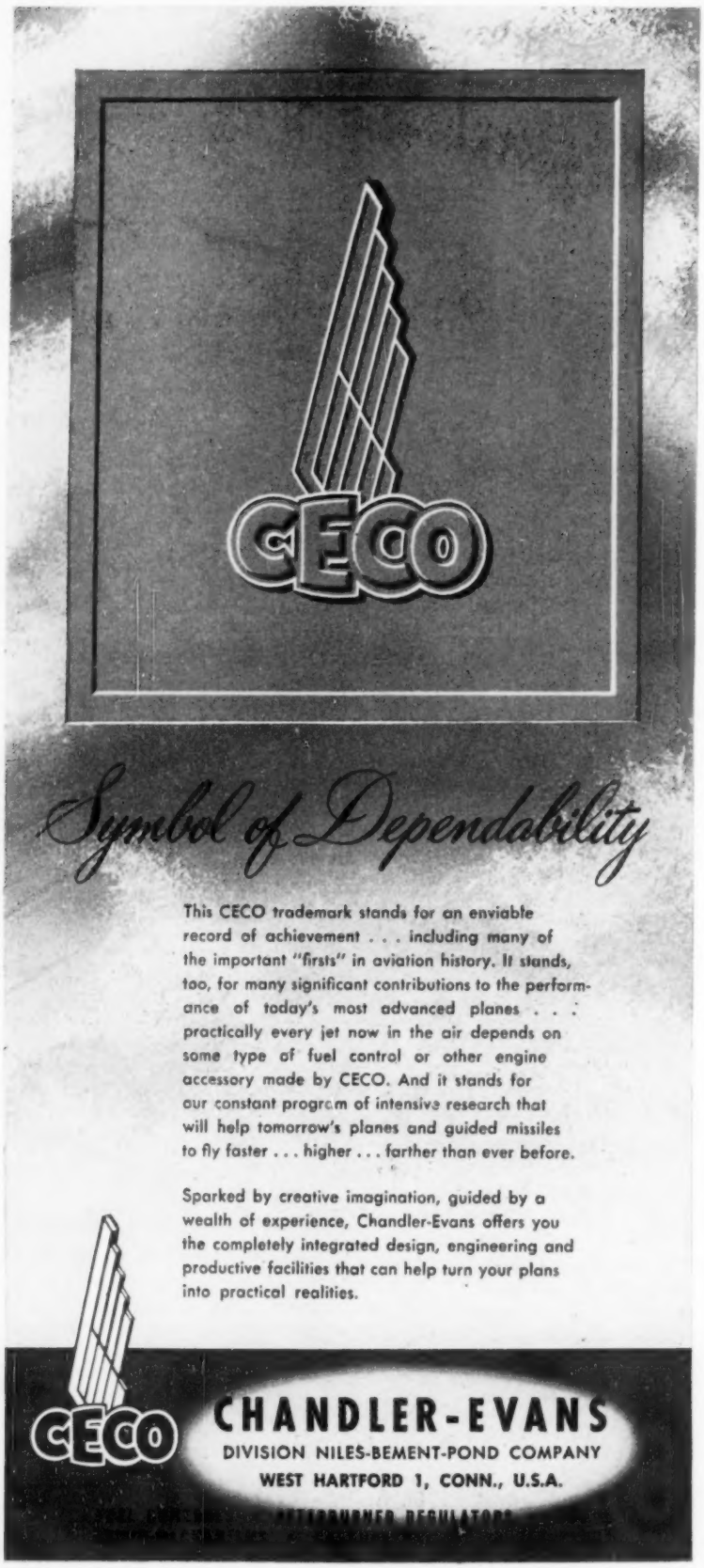
1-19A

Profit-Building **IDEAS** For Business


CECO
Symbol of Dependability
This CECO trademark stands for an enviable record of achievement . . . including many of the important "firsts" in aviation history. It stands, too, for many significant contributions to the performance of today's most advanced planes . . . practically every jet now in the air depends on some type of fuel control or other engine accessory made by CECO. And it stands for our constant program of intensive research that will help tomorrow's planes and guided missiles to fly faster . . . higher . . . farther than ever before.
Sparked by creative imagination, guided by a wealth of experience, Chandler-Evans offers you the completely integrated design, engineering and productive facilities that can help turn your plans into practical realities.
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weeks and 250 man-hours, Gen. Smith says.

AMC has also used electronic computers to calculate life expectancy tables for jet engines and the amounts of basic industrial materials which would be needed in an all-out war (as a function of time) to permit an orderly build-up of military output.

▶ **AMC Computer Center**—Problems like these, which previously were solved by approximate methods, lacked desired timeliness for management use, or were not undertaken at all, will now be solved on the new AMC Univac. The Methods Research and Analysis branch, (under the Comptroller's Office), headed by Lt. Col. C. R. Gregg, is charged with "care and feeding" of the new Univac. One of Gregg's tasks is to find new operational problems which can be advantageously solved on the speedy new computer.

On an average problem, Univac is 40-50 times faster than punch-card machines, but in some types of problems, its speed advantage may run much higher. But more important than speed alone is the ability of the machine to perform long sequences of varied operations at rapid speeds without human intervention.

Although Gregg's section is concerned with immediate applications of Univac to existing problems, and McDowell's group is engaged in longer-range planning, the two are expected to work closely together. Newer computers, such as the IBM 702 which AMC hopes to rent, will be put to use and evaluated at several other depot and base locations. Univac will probably be used as a test bed for McDowell's systems engineering studies.

▶ **Speed Important**—The high speed of electronic computers really pays off in budgetary calculations where the end result must reflect latest military requirements. In the past, using slower punch-card machines, it has taken AMC seven months to prepare its finalized budget, covering 800,000 different items which it procures and another 400,000 which it buys from the Army.

At any point in this seven-month cycle, a change in military requirements can force a complete revision in the budget. For example, an increase in the number of bombers, at the expense of transports, is reflected down to such things as the number of spare vacuum tube types which must be procured.

Even after the initial budget is prepared, overall USAF or Defense Dept. considerations may send it back to AMC for fast revision. Finally, budget cuts made by Congress require still another revision and reallocation before AMC buyers can start procurement. With the application of electronic computers and data processing devices Gen-

**PRINTER** to speed Univac output.

eral Smith believes that AMC can greatly reduce its budget preparation cycle.

## How It Began

Air Force interest in applying high-speed computers to its management and mobilization problems began in 1947, shortly after the first electronic computers were developed.

In the Pentagon, when Gen. Rawlings was USAF comptroller, the USAF's Planning and Research division first studied the possibility of using computers to reduce war plans into ultimate budgets and funding allocations. For instance, how many aircraft, bases, airmen, tools, test equipments, tugs, spare parts, etc., are required to support a bomber wing? These initial studies were made by Marshall Wood, now with the Defense Dept., and Dr. George Dantzig, now of Rand Corp.

In 1948, under Col. McDowell, this Planning Research group of 40 mathematicians, statisticians and logistics experts began analyzing inter-industry relations, using techniques sometimes called "input-output." For instance, if a million-dollar contract is placed with an aircraft manufacturer, what percentage of this money finds its way into other segments of industry, such as avionics, engine, accessories manufacturers? Also, what percentage filters down to suppliers of such raw materials as aluminum, steel, copper, and others?

► **Early Techniques**—To solve complex problems like these, linear programming math techniques were developed, could not be processed effectively on then-available computers. A simplified triangular matrix system was devised and tested, using punch-card machines in 1949. In 1950, the group got the opportunity to use the newly developed Bureau of Standards SEAC computer on these problems, in a war planning factors study. (SEAC was developed with USAF funds.)

In 1952, USAF headquarters in the


3rd of a Series

...another

JET-HOT FASTENING PROBLEM

solved by Delron

problem: The Northrop F-89 all-weather interceptor carries large numbers of devastating rockets in wing tip pods. Northrop engineers required a self-locking nut for installation of rocket firing tubes operating under high heat and stress. Nuts were to stay locked under extreme vibration and high temperatures, yet present no problem on removal.

solution: Dura-Loc 1200 High Temp Nuts successfully met all requirements of this spectacular application, and are specified by Northrop on all F-89's now in production. The dependable service record throughout industry of many millions of nuts has proven the safety, reuseability and labor-saving features of Dura-Lock High Temp Nuts.

Rocket pod of Northrop F-89 Interceptor uses Dura-Loc 1200 High Temp Nuts to provide dependable fastening for rocket firing tubes.

This is another example of Delron's long service and design experience at work—solving critical fastening problems!

WHAT IS YOUR CRITICAL FASTENING PROBLEM?

THE DELRON COMPANY, INC.

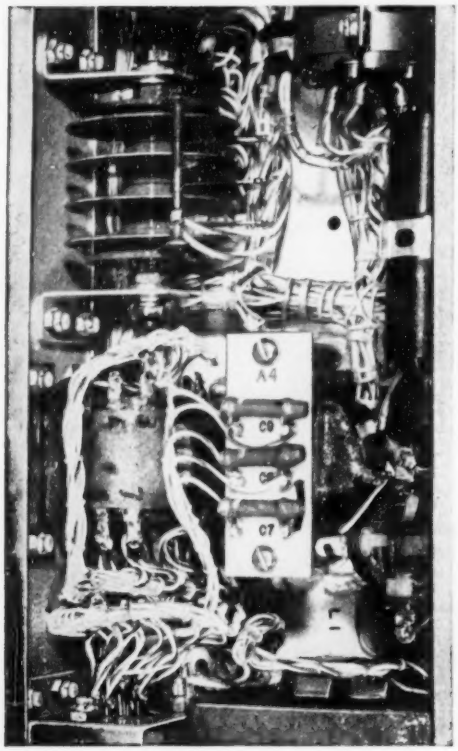
5224 Southern Avenue, South Gate, California

Clip this ad to your letterhead, and mail for product data on items checked: AW-3

- ☐ Fasteners to 1200°F. operation
- ☐ Fasteners to 1600°F. operation
- ☐ Sandwich structure fastening

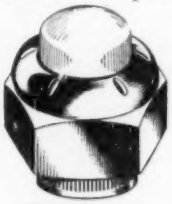
Name_____

## FASTENER PROBLEM



# How a single fastener solved several design problems

**Raytheon Manufacturing Company,** Waltham, Mass., designed this AN/APN 22 radar altimeter for the Navy Bureau of Aeronautics. The importance of holding weight to a minimum imposed space and clearance limits that made fastening methods particularly important. Ready fastener accessibility was a "must" to meet both producibility and field maintenance requirements. Protection of components against loosening due to aircraft vibration was necessary. And it was desirable to eliminate the possibility of protruding bolt ends chafing vital wiring.



ESNA clinch nut, with nylon cap

**Clinch type ELASTIC STOP® nuts,** with nylon caps, are now used by Raytheon. They are simply installed and permanently positioned for easy assembly or dis-assembly by a simple clinching operation. Particularly designed for use in thin section sheet metal components, they are manufactured in a series of shank lengths permitting installation in sheets from .020 to .163 inches thick.

**Mail our coupon for design information on a variety of ESNA® cap nuts and other types of self-locking, vibration-proof fasteners.**

ESNA

**Dept. N44-825, Elastic Stop Nut Corporation of America**
**2330 Vauxhall Road, Union, New Jersey**

*Please send me the following free fastening information:*

☐ Bulletin on Clinch, Cap and other ELASTIC STOP nuts

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____




Pentagon got its Univac, one of the first of the new highspeed computers to be produced in quantity. This machine has been used to estimate requirements for war-consumable items, test linear programming techniques, support development of official USAF programs, solve operations research programs, etc.

The same year, Wright Air Development Center launched a program which resulted in a contract (let in 1953) for the development of a military information flow device (MIFD) at the Monroe Calculatoring Machine Co. MIFD is an experimental digital computer designed for material inventory control at a large airbase. Delivery is presently scheduled for August 1955.

## Logistical Objectives

AMC has given its new Logistical Systems Research and Planning group a broad area to explore, as evidenced by some of the objectives listed in its charter:

- "Sponsor or conduct research for improved mathematical factors, tables, data, and techniques to provide better requirements determinations, budgets, procurement control, provisioning, accounting, distribution control, maintenance control, and disposal determinations through the use of electronic computers and data processing equipment.
- "Serve as a point of contact for coordinating modifications in directives, regulations, or manuals affecting existing logistic systems and techniques in major AMC functional areas which may currently or later be more efficiently performed electronically.
- "Sponsor or conduct research into the logic and necessity of data recording, collection, and reporting throughout all AMC functions with the objective of reducing current operating expenses and permitting minimum cost for the design and production of electronic computers and data processing equipment."

▶ **Operating Framework**—AMC has already established certain basic criteria for its world-wide electrodata system, including:

- Data input at various points on an airbase must be transmitted electronically into the overall data processing system and should require a minimum of translating devices (to convert data from cards to tape, or vice versa). Considerable thought is going into the subject of base-level data input devices and what form they should take, McDowell says.
- Standard electrodata machines, developed by industry at its own expense and having commercial applications in peacetime, must be used. This will save the Air Force the cost of sponsoring development of specialized machines, permit it to borrow industry's machines

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in the event of national emergency.

• An absolute minimum of human intervention should be permitted in the system. This means that all electrodata machines, possibly made by a variety of manufacturers, must be able to communicate with one another without requiring human translation at intermediate points. The only human intervention permitted should be for the exercise of judgment, which cannot be synthesized with equipment.

• System must be versatile and have adequate capacity eventually to handle monetary inventory property accounting, maintenance scheduling control, payroll, appropriation accounting, and other operational data. Present indications are that the system must accommodate hundreds of decimal digits or alphabetical characters per stock-numbered item. The need is much greater than what is possible with present punched cards.

► **Data Center Location**—One of the knotty questions which McDowell's group is pondering is: How many data processing centers should there be and where should they be located.

One possibility is to put a center at each of the 15 AMC depots and AMAs. Another is to set up five centers, one each for handling aircraft, engines, avionics equipment, ground support, and general supplies.

Another possibility calls for three centers—for high-cost, medium-cost and low-cost items. The thinking behind this arrangement is that fewer transactions and more data per transaction are involved in the high-cost items than for low-cost items. A single centralized data center appears unlikely because it would prove too vulnerable, McDowell says.

## Rapid Advances

It was only five or six years ago that AF's Planning Research group in the Pentagon was stymied because its mathematical models were beyond the capabilities of computers of that day, McDowell recalls.

Recent developments, such as high-speed printers (to record computer output), improved input equipment, and greatly increased storage (memory) capacity promise to make "yesterday's dreams a reality," McDowell says.

► **They Won't Talk**—In fact, keeping pace with the computer art is one of McDowell's biggest problems. The art is so new and fast-changing, the industry so competitive that many companies, particularly the smaller ones, are reluctant to disclose their new ideas, he says. To assist in this area, AMC and Wright Air Development Center have organized a joint project effort.

To keep abreast of new developments, and to keep the industry posted on AMC thinking, McDowell and his group are meeting with the presidents and staffs of large business machine companies to outline AMC needs and to enlist assistance in their product planning and business applications studies.

By this fall, McDowell hopes to have initial system plans at the point where budgets can be prepared and training programs started. When the Monroe MIFD is delivered next summer, it will probably get a trial at some AF base, to test inventory data handling tech-

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Atlanta Municipal Airport, Atlanta, Ga.
Ft. Wayne Municipal Airport, Ft. Wayne, Ind.
City of Niagara Falls, Niagara Falls, N. Y.
Wichita Municipal Airport, Wichita, Kan.
City of Jacksonville, Jacksonville, Fla.
City of Colorado Springs, Colorado Springs, Colo.
Port of Oakland, Oakland, Calif.
Geiger Field, Spokane, Wash.
Port of Seattle, Seattle, Wash.
City of Syracuse, Syracuse, N. Y.
City of Phoenix, Phoenix Ariz.
Tulsa Municipal Airport, Tulsa, Okla.
City of Dayton, Dayton, Ohio
City of San Diego, San Diego, Calif.
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Boeing Airplane Company, Wichita, Kan.
Kaiser Manufacturing Co., Willow Run, Mich.
North American Aviation, Columbus, Ohio
Hayes Aircraft Corp., Birmingham, Ala.
Bell Aircraft Corp., Buffalo, N. Y.
Lockheed Aircraft Corp., Burbank, Calif.
Canadair Ltd., Montreal, Canada
Piasecki Helicopter Corp., Morton, Pa.

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Civil Air Patrol
United States Navy
Civil Defense Departments
Institute of Inter-American Affairs, Tegucigalpa, Honduras
Telecommunications Dept., Nassau, Bahamas
Civil Aeronautics Administration, Alaska, Honolulu, Wake Island, Jamaica, N. Y., etc.

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General Precision Lab., Pleasantville, N. Y.
Atlantic Aviation Service, Wilmington, Del.
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niques. IF AMC can obtain one of the new IBM 702s in time, it will probably be installed at some AMC depot for a similar evaluation.

## Personnel Problems

The mushroom growth of the computer industry has created a serious shortage of personnel capable of developing mathematical models of the problems to be solved, called "problem formulators, programming the problem for computer solution, and operating and maintaining the machines.

▶**Non-Professionals**—A year ago, Lt. Col. Gregg and his staff faced the prospect of developing a group with the technical capability of operating and maintaining AMC's Univac, despite this nationwide shortage of qualified personnel. He decided to experiment with the training of non-professionals (without math or engineering degrees) who had had considerable experience in programming AMC's punch-card machines.

Today, approximately half of AMC's 15 Univac programmers are these non-professionals, and Gregg says the policy has really paid off. Others on the 50-man staff include 19 enlisted airmen, 17 with degrees in math, physics, electrical engineering and other technical fields.

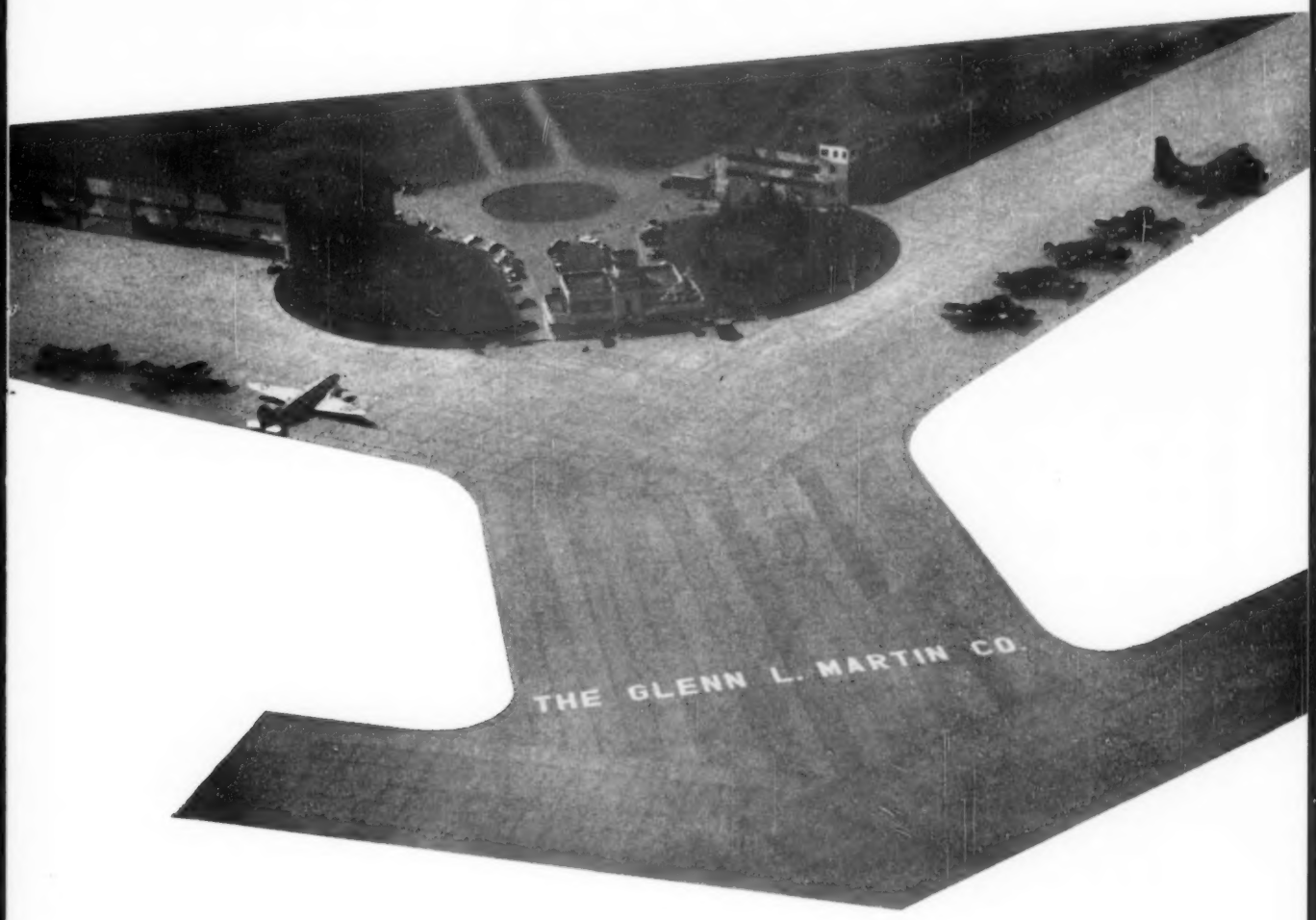
▶**On-the-Job Training**—More than a year before Univac was scheduled to go into operation, the first AMC personnel were sent to Remington Rand training schools. This was followed by on-the-job training with Rem Rand's and the Pentagon's Univacs.

The AMC group initially attacked small problems or small, simple portions of large problems, programmed them on tape, then ran them off on the Rem Rand or Pentagon Univacs to check their techniques. The largest problem programmed to run to date by this group is the Fiscal '56 budget for aircraft spare parts.

Probably the most difficult posts to fill in a computer center are those of problem formulators. These are the men who must convert the problems—many times not well-stated—into a series of logical steps, from which the programmer prepares the coded machine instructions. Gregg hopes to develop a small nucleus of mathematicians who can develop or apply new machine-math techniques to enable Univac to handle a wider variety of problems.

## About Univac

AMC rents its Univac system from Rem Rand for about $25,000 per month, with an option to purchase whereby a portion of the rental will be applied against the purchase price. The machine, operating at a pulse rate of

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2¼ mc., can perform 1,900 additions or subtractions per second. Univac can also perform 465 multiplications, 257 divisions, or 2,740 comparisons per second.

► **Self-Checker**—The portion of the machine which performs the arithmetic operations is built in duplicate so each operation can be performed simultaneously in the two sections and the answers compared. If the two answers are not identical, indicating a malfunction, the machine automatically stops its computation.

Short-term storage (memory) is provided by mercury delay lines; long-term storage by magnetic tape units, of which the AMC machine has eight. Each tape is capable of storing close to 1.5 million decimal digits or alphabetical characters. Access time to any number in the highspeed memory is between 40 and 400 microseconds. Approximately three minutes is required to scan all the characters on a reel of tape.

A single 10-in. reel of magnetic tape can hold as much information as 18,000 conventional punch cards, and requires only 1/60th as much storage space. This is an important consideration with AMC which must store vast amounts of data for possible future reference.

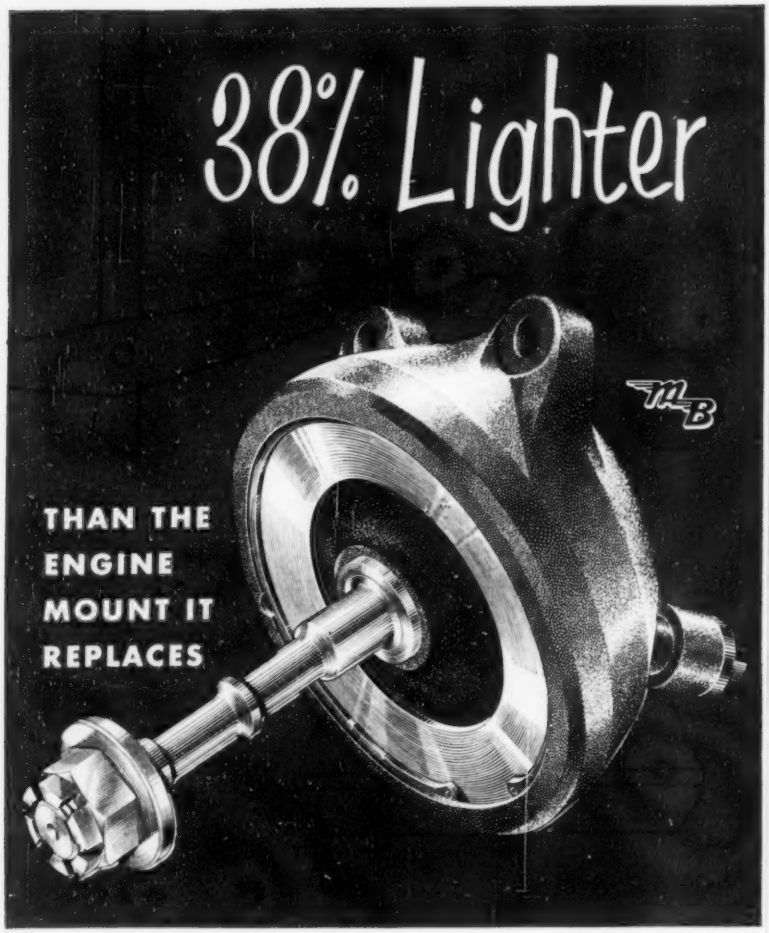
Within the next couple months, AMC expects to get a new highspeed printer which should greatly speed up the process of getting information out of the computer, presently a major bottleneck. The new device can print 3,900 characters per minute, roughly 65 times the speed of previous printers. Another pending addition is a card-to-tape converter for automatically transferring information from punch cards to magnetic tape.

No computer description would be complete without mentioning the number of tubes and diodes used; Univac uses 5,400 tubes and 18,000 diodes.

► **No "Giant Brains"**—You don't hear the terms "thinking machines" or "giant brains" in conversations with Smith, McDowell, or Gregg. They want to strip away any aura of mystery which might scare off hard-headed military men who could make good use of Univac.

One of Gregg's tasks is to educate AMC personnel on Univac's capabilities, what kind of problems it can solve. In this respect, Gregg emphasizes that Univac, and similar computers, should be used to provide complete management tools, not merely contribute more heavy reports which military management must scrutinize.

If management will specify the significant trends they are looking for, and the criteria that can be used to spot them, chances are that Univac can be set up to spot these trends while it is solving the basic problem, Gregg says. ■ ■ ■

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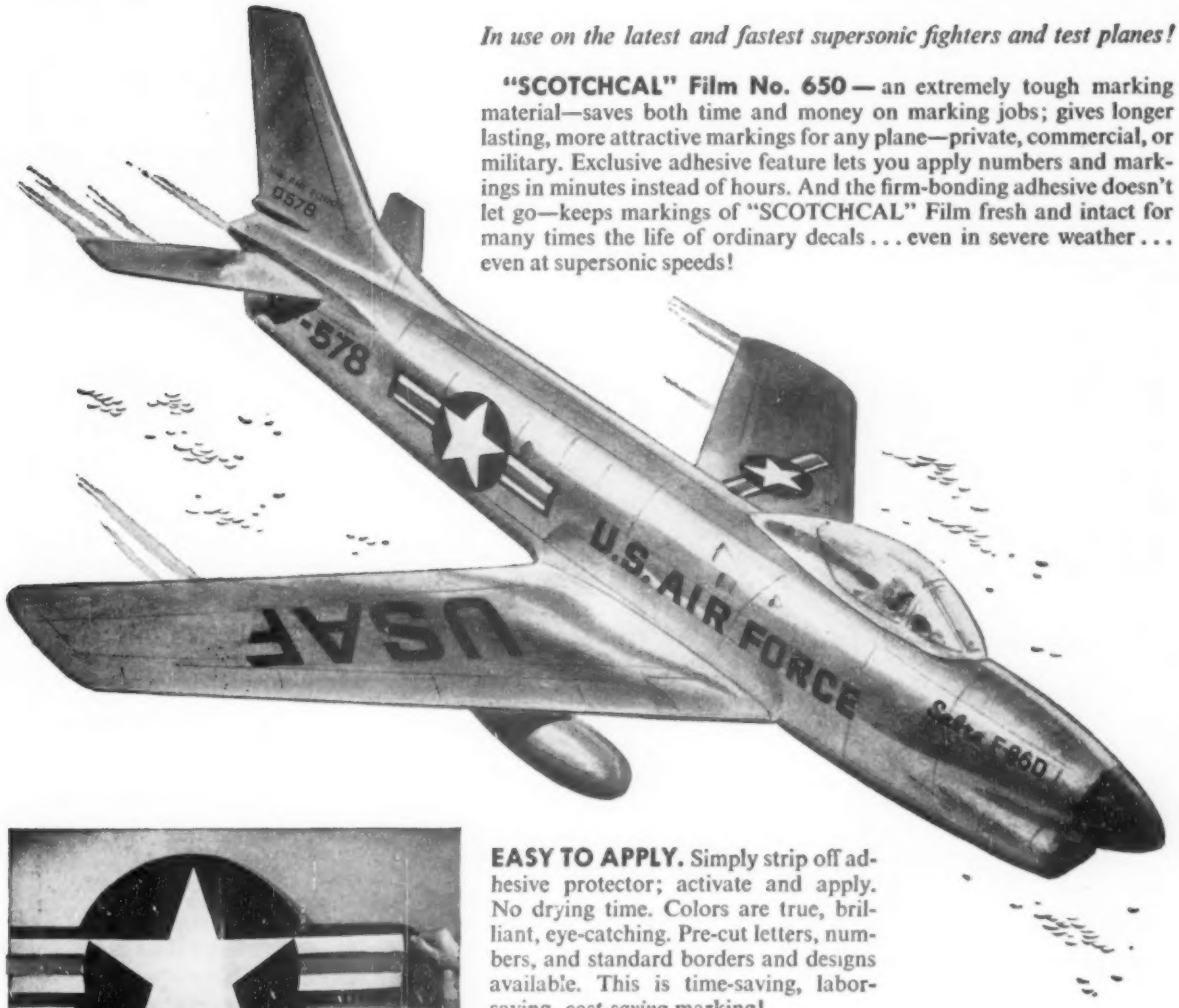


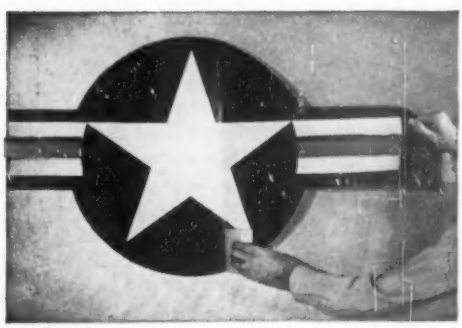

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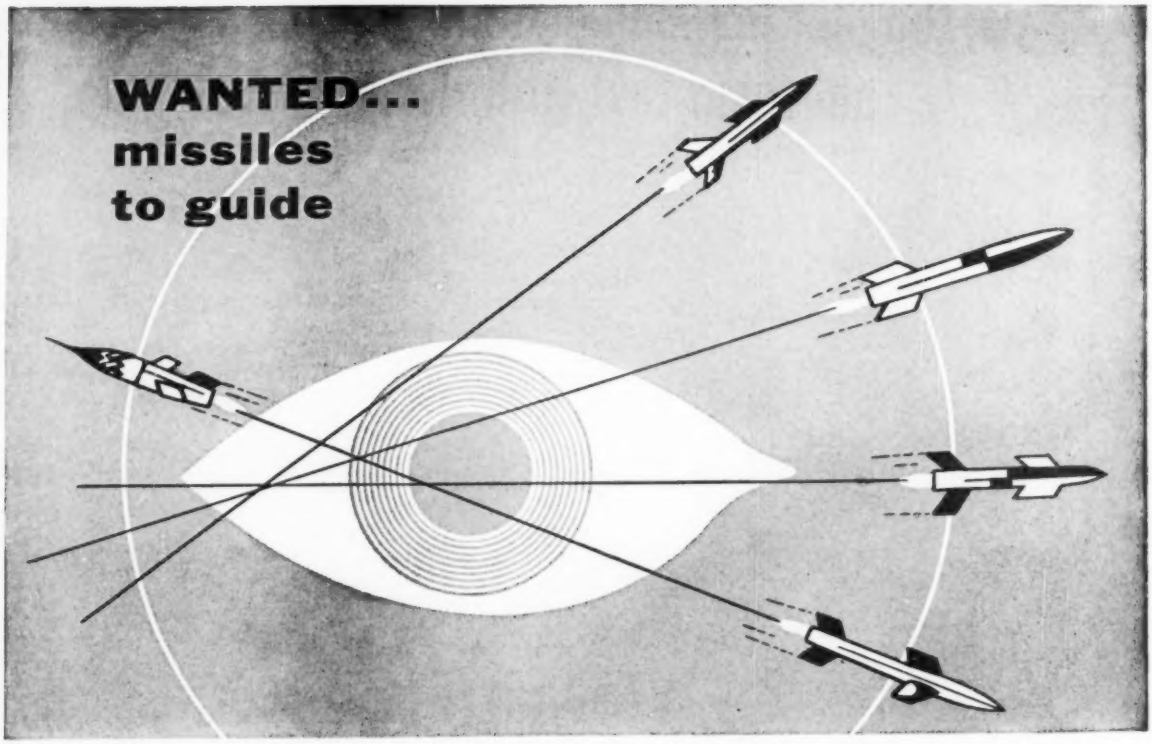


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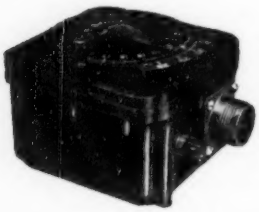

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# Packaging Keeps Pace With Air Cargo

By George L. Christian

**The growing trend toward air transport of cargo has helped make packaging for the United States Air Force big business. According to figures just released at Air Materiel Command headquarters, yearly packaging cost is approximately three quarters of a billion dollars; expressed in another way, the Air Force spends about 6 cents of each purchase dollar for packaging the equipment it buys.**

To put mass air transport of cargo in its proper perspective, one need only look at the rapidly growing stable of transport and troop carriers that double as cargo craft.

Now flying on daily freight chores are the giant Douglas C-124 Globemaster, the twin-boomed Fairchild C-119 Flying Boxcar, the Boeing C-97, Douglas C-54 and C-47, and Curtiss C-46.

Looking ahead, there are the Chase C-123, now under construction at Fairchild, and the West Coast turboprop fleets: Lockheed's C-130 and Douglas' C-132 and C-133.

## New T.O.

This new importance of packaging recently led the Air Force to take a long hard look at its packaging methods and came up with a new technical order (T.O. No. 00-85-9) and new packaging ideas which are completely revamping its packaging methods.

▶ **Savings Sought**—The three basic objectives: save money; save weight (tare); save space (cubage).

A chart forming part of the T. O. greatly simplifies the task of how to package a given item and is "a condensation of a whole book shelf of packaging information," says Col. R. L. Mason, Chief of Packaging Branch, Transportation and Packaging Division, Directorate of Supply and Services, Air Materiel Command.

Called the "Container Selection Chart for Air Shipments," the chart tells a packer at a glance how to select a container and what type of packaging should be used for the shipment at hand. It tells him how to package the unit in the most economical way from a weight and space standpoint, consistent with delivering the article in serviceable condition.

In a parallel endeavor, AMC is constantly looking for lighter-weight materials which are suitable for its packaging needs.

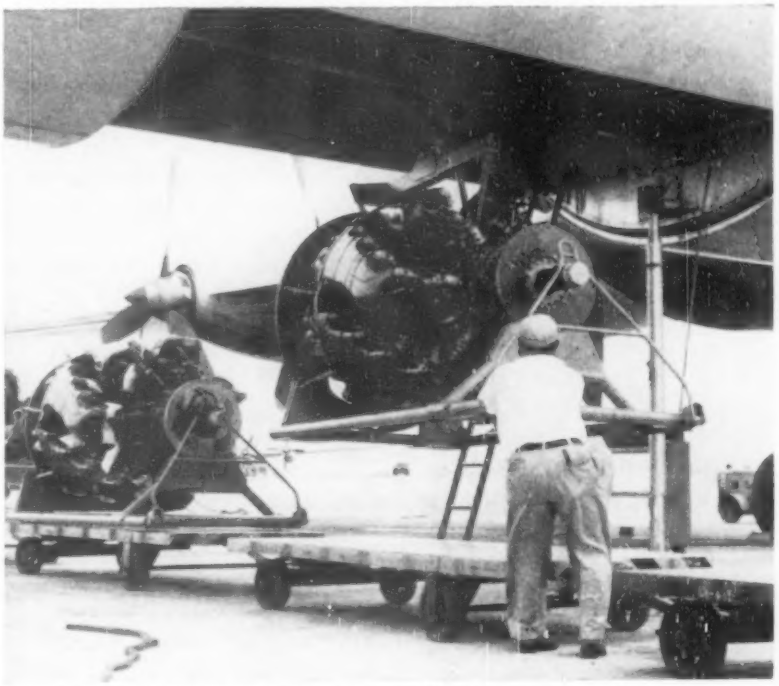
Example is tests of nearly unbreakable polyethylene bottles as liquid containers.

And Fiberglas promises to be a good, lightweight substitute for metal containers. It permits making hermetically tight seals, yet is strong and highly resistant to breakage.

▶ **Excellent Results**—To date, results of AMC's endeavor to streamline, simplify and lighten its packaging methods and materials have been encouraging.

Take the field of rocket containers. The Air Force is now buying these containers under a new performance specification, MIL-R-4789, at a dollar saving of nearly 50% over the old-style containers. These containers are purchased "by the thousands," so the economies are large.

Weight and space savings are equally impressive. T.O. 00-85-9 has resulted in a tare saving of approximately 66% (tare per 100 lb. shipment was cut from 45 to 15 lb.), while cubage has been



**LIGHTWEIGHT** dollies for air transport of aircraft engines save . . .

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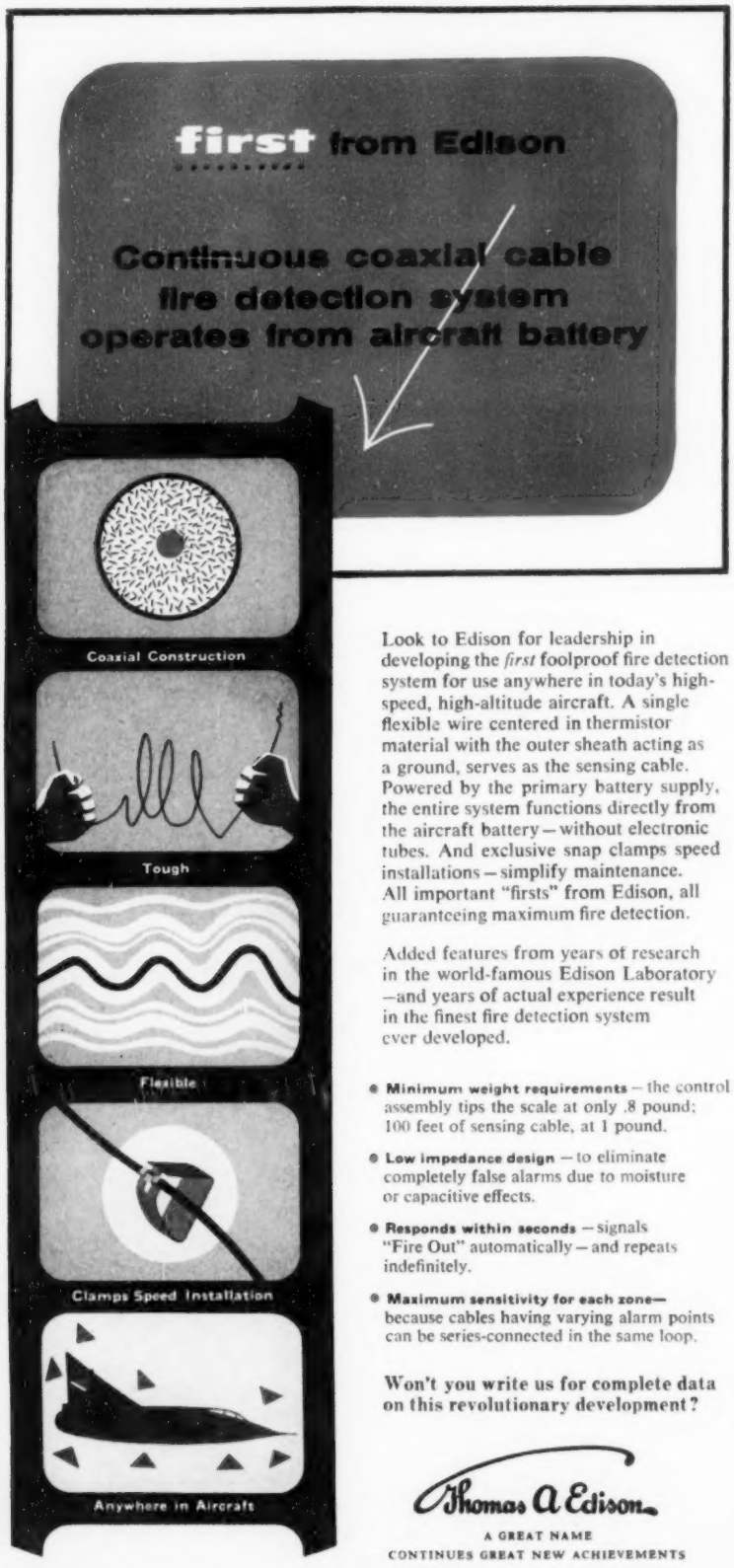


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- **Maximum sensitivity for each zone**—because cables having varying alarm points can be series-connected in the same loop.

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reduced by approximately 22%.

These weight and space savings are resulting in greatly increased transport plane efficiency because each plane can carry so much more equipment now that the weight and size of the surrounding packing has been so sharply cut.

## Questionnaires

Another program instituted at approximately the same time as the issuance of the T.O. (last October) was the distribution of thousands of "Packaging Questionnaires." These are self-addressed postcards, packed with each item, to be filled out by the person opening the package.

To date, AMC has had returns on over 24,000 cards, says Col. Mason. This good response was helped by Gen. Rawlings, AMC Commanding Officer, who sent personal messages to each major Air Force commander, asking for organizational support of the inquiry program.

Interesting sidelight of the program is that, of the over 24,000 cards returned, only 130 reported that the item in question was unserviceable. Another 106 complained that the container was too large and 128 made other miscellaneous comments (such as: the item was poorly packed, lumber used was heavier than necessary, too much wrapping on the inside, etc.).

▶ **Pinpoints Problems**—The card system quickly shows where packaging is adequate or poor. If the latter, it also puts the finger on the individual responsible. If the method and not the individual is at fault, the cards place the responsibility squarely where it belongs.

The card system can also show another important fact—too-good packaging of low-cost items which require but the simplest type of treatment. This too can result in considerable savings. As Mason put it, "The cards will allow us to tailor the package to the item being packed."

Typical complaint card: "Five tiny washers were packed in a 12-in. box with 65¢ postage on it." Typical of the bright side: "The lens-dome light arrived at this station in an excellent condition."

Questions asked on the franked cards include Nomenclature, stock no., is the item(s) serviceable, if not serviceable, is it distorted, punctured, dented, crushed, broken, rusted, torn, mildewed, wet, other; did we provide too much protection for the item; packed by (activity); additional comment; reporting base or installation.

▶ **Coding Cards**—Still another system recently inaugurated by the Air Force to streamline its packaging and inventory procedures is the establishment of a Packaging Data Card system using

EAM (electrical accounting machine) cards. The cards are codified—eight different symbols show such information as the item's freight classification, method of preservation, quantity in unit pack, etc.

This codification enables AMC to expedite shipments and predict with considerable accuracy just how much of an airlift will be required to move a given quantity of freight a given distance. Also the cards allow shippers to consolidate items of similar rates and dispatch them together. This effects a real money savings because if items of dissimilar freight rates are packed together, the entire shipment is charged for at the higher rate.

To get the system going, packaging men started with all items weighing less than 200 lb. They found that there are over 600,000 items in this category alone.

## Package Studies

Still striving for "more Air Force per dollar," Col. Mason pointed to other steps taken to save the taxpayer's dollar.

The Air Force decided that overseas airfreight did not need waterproof packing as did overseas surface freight. Eliminating waterproof packaging saves a good deal of money, because domestic plywood is considerably cheaper than water resistant plywood.

Still another device the Air Force is emphasizing to expedite freight movements is greater use of palletized shipments.

Operation "Opportune Airlift" is another economy move. This is the term used for training flights which check out or indoctrinate flight crews and may at the same time carry cargo.

These freight flights are, of course, unscheduled.

AMC recently increased the maximum weight of objects shipped in cardboard containers from 70 lb. to 90 lb., allowing cargo in this weight bracket to be packed in relatively light cardboard boxes instead of the much heavier wooden boxes previously used.

A new, universal jet engine stand has been put in production, according to Col. G. E. Keller, Deputy for Plans and Operations, Directorate of Supply and Services. The stand will save a lot of money because it will handle just about any type of jet engine. This eliminates the necessity of custom-building a different type of stand for each type engine, making that stand useless for any other engine and obsoleting the stand with the engine, as is now the case.

▶ **'Single-Trip' Container?**—AMC is evaluating the "single-trip," one-shot container vs. the reusable type to determine which is the more economical.

It is more economical in the long run


MASS PRODUCTION to PRECISION TOLERANCES

Rapid and accurate production of precision parts depends on fast machines, engineered to produce within close tolerances. Axelson's Los Angeles plant is one of the Pacific Coast's best equipped and most versatile machine shops. A new modern plant at Montebello, California, has expanded facilities. This addition reflects increased contracts for aircraft components resulting from our record of maintaining production schedules at competitive prices.

We invite personal inspection of our facilities, but in the meantime, we will be glad to forward Bulletin 5037 which gives you a preview.

A PARTIAL LIST of Airframe Manufacturers Using Axelson-built Components

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North American Aviation, Inc.
Lockheed Aircraft Corporation
The Glenn L. Martin Company
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KELLERING

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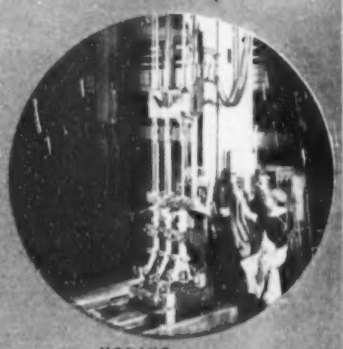
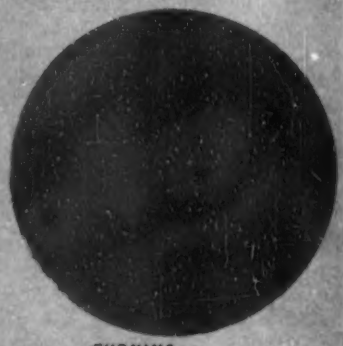
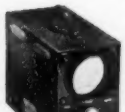
BORING


HONING


TURNING

Engineering that gets the job done . . . .

Land-Air



*An example of Land-Air research, design and engineering is the Engine Analyzer—an electronic wizard that tells you what's going on inside an engine. It locates troubles immediately, saves lost time, parts, and labor. It pays for itself—makes flying safer.*

WRITE FOR THIS BOOKLET DESCRIBING OUR SERVICES AND PRODUCTS

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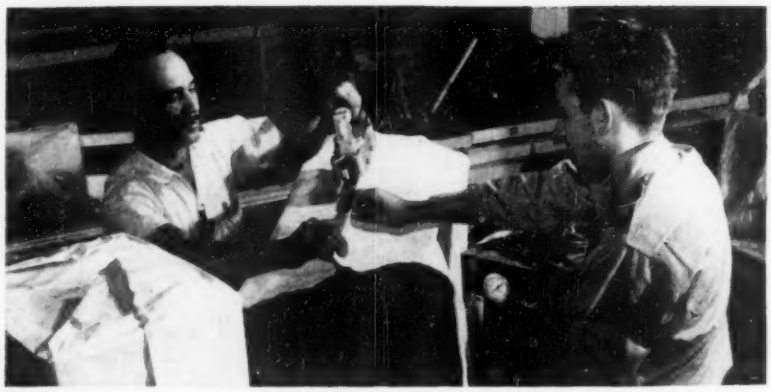
FOREIGN REPRESENTATIVE:
AIR CARRIER SERVICE CORP. - CABLE "AIRCAR"

**ELECTRONIC EQUIPMENT** is sealed in vapor-proof package, with desiccant added.

to buy large quantities of one-shot containers which will be expected to last for only one trip (although they may possibly last for several trips if undamaged) and discard it, or follow current practice of buying relatively expensive, durable metal containers which have a long life?

AMC will have to take into account two drawbacks of the durable containers: they pose storage and repair problems.

▶ **New Rocket Container**—The new-type container for the 2.75-in. Mighty Mouse airborne rocket was recently proposed by the Standard Container Co., New Jersey; was accepted by AMC. It costs approximately one half as much as the existing container and it gives the rocket much better protection against damage.

Lloyd E. Hayer, AMC Packaging Technician, told AVIATION WEEK the new container saved $3 million a year. It would have saved $8 million had actual rocket procurement met purchasing forecasts.

Old-style containers were made of drawn aluminum tubes, sealed at one end. They carried the whole rocket and were packaged four to a bundle. The sides were easily caved in, damaging the rocket or making it difficult, if not impossible, to extract the rocket from the container.

The containers were sealed at the other end with compression-type rubber gaskets which were subject to leakage if not properly installed.

Also the rocket was packed whole. If different kinds of heads were desired, the rocket had to be disassembled and the proper kind of head installed.

The new container does away with all this. Also clustered in groups of four, they are made of 28-gage tin plate lined with fibreboard. Each group of four is packed in a wooden box, giving great strength but costing a weight penalty of about 20%. The containers hold only half a rocket— either the head or the motor. Thus the proper kind of head may be assembled to a motor without resorting to any disassembly. The containers are much more rugged and consistently deliver the rockets in serviceable condition.

The new units are hermetically sealed and require no inspection for the first 10 years. Old-style containers required yearly re-torquing of the lids. The container is equipped with a tear-strip opener, like a coffee can, and is labeled a "single-trip container with reusable feature—the top can be screwed back on and will give a closure good for another six months."

The new containers entail lower shipping costs. This is because the motors, which are cheap to transport, can go as one shipment, divorced from the heads which are expensive to ship because of their explosive quality.

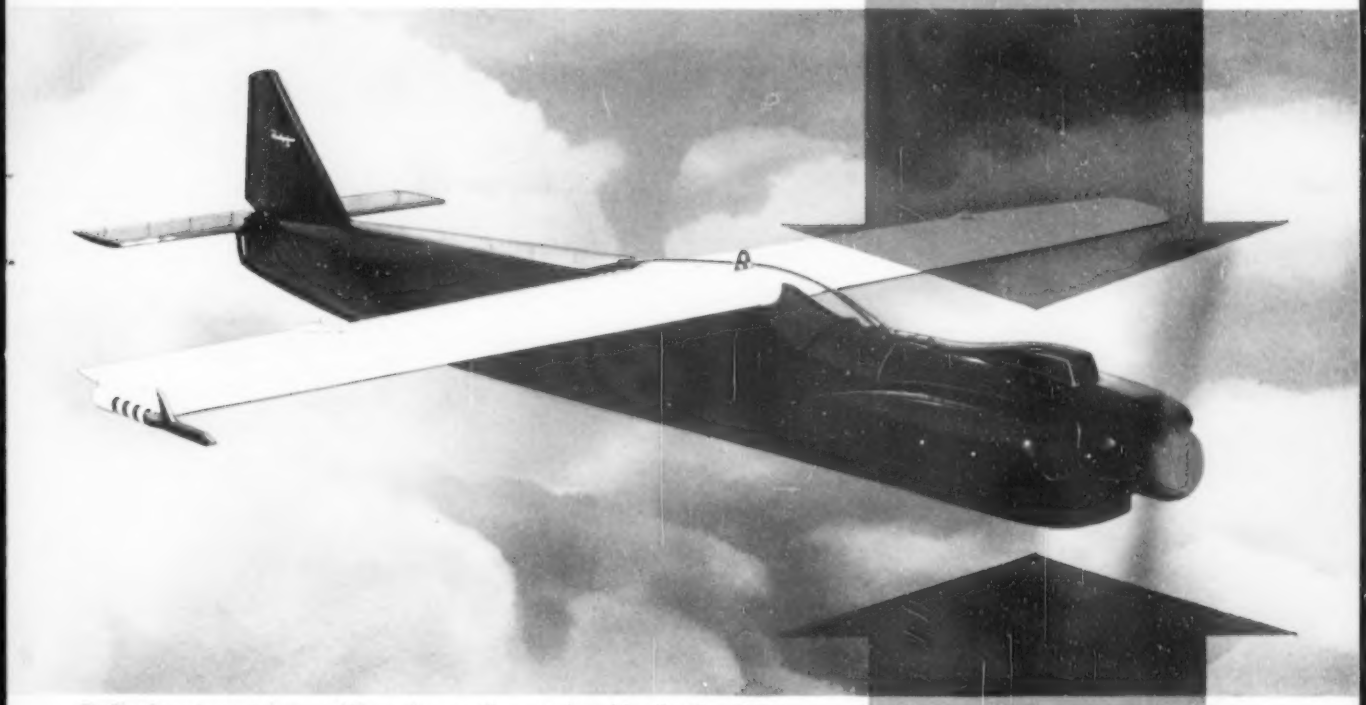
Previously, the motor traveled at the same high rates as the head.

▶ **New Universal Container**—AMC technicians have also come up with a new type of universal metal container which is used to carry delicate gyro and other types of aircraft instruments.

The old-type can (of which there are 1¾ million in AMC's world-wide logistics system today) is made up of six parts: the can, lid, rubber sealing gasket, ring, bolt and nut. It is difficult to install the rings so they squeeze the lid down on the can to make a hermetically tight seal with the gasket in between. The seal is effected by tightening the single bolt. If not done carefully, and if the lid is not lightly tapped around its perimeter during tightening, the seal may not be tight and moisture leaks in.

The new unit is called a "Twist-Lock" container. Top locks on the body of the can by turning it through 90 deg. Lid is first turned several degrees by hand. To seat the lid, one of four reinforcement ribs on the lid is hit sharply with a hammer. It is easy to make sure the lid is in the fully locked position by seeing if the anti-pilfer wire holes in lid and body line

# RADIOPLANE ALSO RELIES ON OMOHUNDRO FOR FIBREGLASS PARTS



*Radioplane target drone with engine cowling produced by Omohundro.*

**RADIOPLANE CO.** now joins a constantly growing sector of the aircraft industry in entrusting the production of vital fibreglass components to Omohundro skill.

By equipment and experience, plus the indispensable human factors of resourcefulness, ingenuity and conscientious care in production, the Omohundro organization is ideally qualified to "deliver as expected."

The Omohundro "O" stands for certainty of satisfaction—in quality, finish, strength and security. For practical proof, contact Paul Omohundro Company, Box 696, Paramount, California, TOrrey 6-7001.

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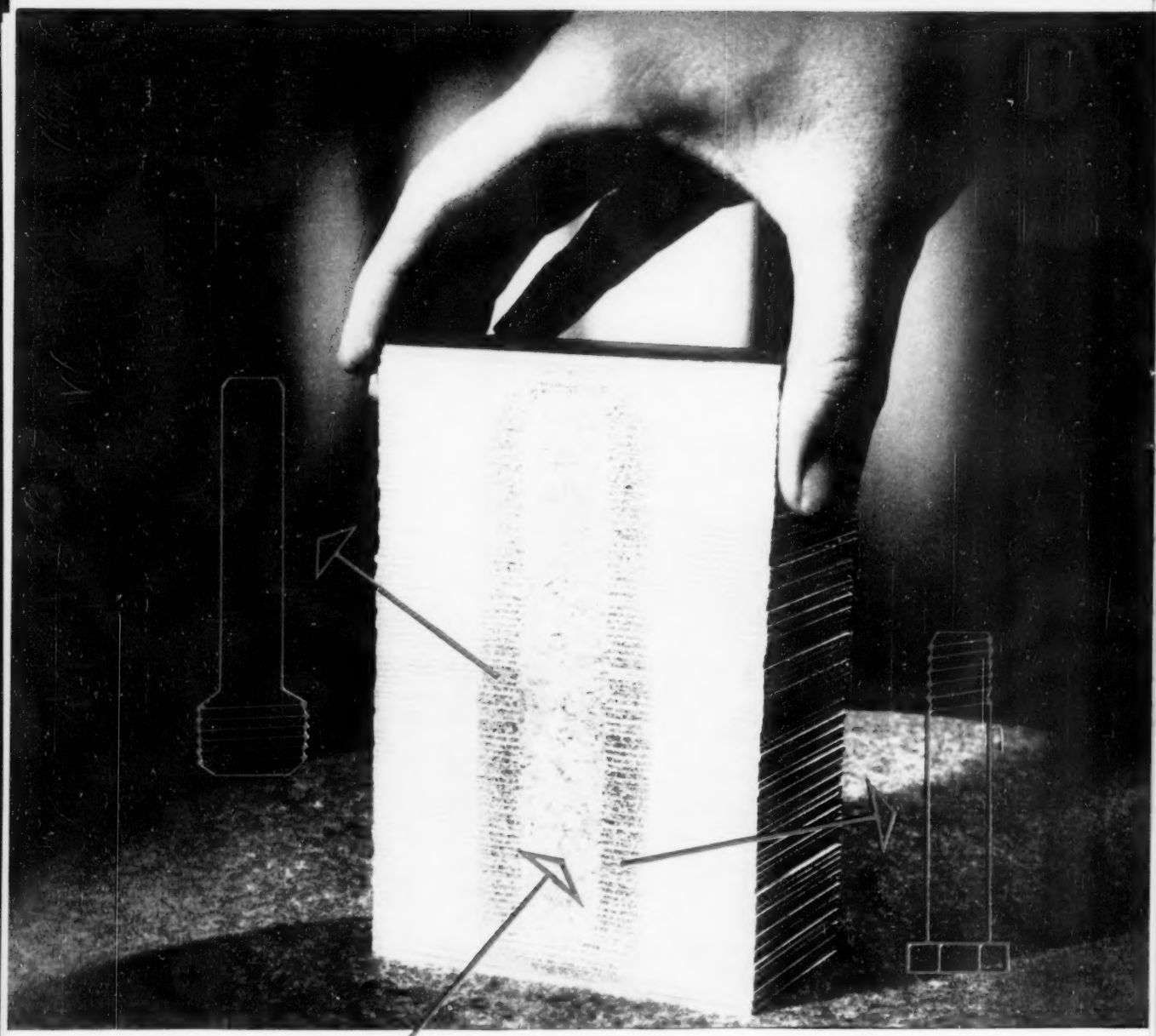

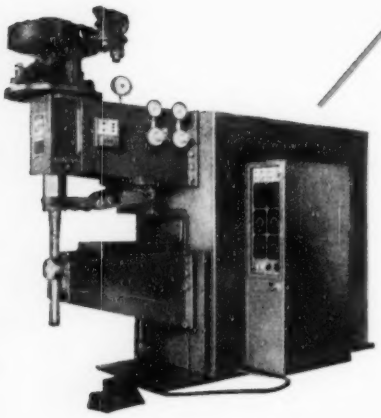

# Martin Aircraft Forms Solid Ingots of Scrap Sheet Titanium with Sciaky Spotwelder

The Manufacturing Research and Development Unit of the Glenn L. Martin Company has developed a technique to utilize virtually all their scrap sheet titanium. A six inch pile of 85 laminations of .064 titanium with two laminations at each end of .091 titanium is joined with one weld on a Sciaky type PMCO 6ST 400 KVA Three-Phase Spot Welder.

The weld nugget forms a solid ingot of virgin metal at least as strong as the parent metal. This ingot can be machined into a variety of titanium parts. An expensive waste is almost entirely eliminated, and the months of lead time required for delivery of titanium for machining is avoided.

Martin Research offers another fine example of Sciaky basic thinking in design with resistance welding equipment to do *more useful work* at the *lowest operating cost* with *maximum reliability.*

*Largest Manufacturers of Electric Resistance Welding Machines in the World*

SCIAKY

4935 West 67th Street, Chicago 38, Illinois

up. The anti-pilfier wire is then run through both holes and sealed with lead.

AMC says that the old-style can is very unpopular with industry. The new style should do away with much of this unpopularity. AMC officials expect the new to replace the old entirely. Cost of the two cans is approximately the same. The new container will come in eight different sizes.

▶ **Precision Desiccant**—The Air Force recently adopted a new, precision packaging formula which, it estimates, will reduce by 35% the amount of desiccant now used to protect supply items from moisture. This means a yearly desiccant saving of some $225,000. The drying agent is packed in a container with the item to be protected.

Previous method was to include 10 units of drying agent in a container per one pound of cushioning agent, regardless of type of cushioning agent used, volume of box, etc.

Now, quantity of desiccant used is determined by volume of container space, water-vapor transmission rate of enclosure, and quantity and quality of the desiccant or drying agent.

Under the new formula, AMC technicians have determined the desiccant requirements for the various cushioning agents such as wood, felt, cellulose, wadding, sponge rubber, bound hair and Fiberglas.

These requirements are set up in tables which spell out the specific amount of desiccant to be used with each type of cushioning agent. The requirements are applicable to both metal and flexible barrier containers and are designed to protect millions of packaged supply items during transportation and storage.

▶ **New Desiccant Procurement**—AMC has initiated action in Fiscal '55 to procure desiccant on a call contract basis.

This means that the manufacturer will ship the desiccant, in the quantities specified, direct from factory to the using activity. It will be shipped in one-trip, fiber drums instead of usable metal containers. This procedure is expected to produce at least a 25% saving in transportation, storage, labor and handling. Old purchasing method was to buy large quantities of desiccant at a time, store it at prime depots whence it was shipped.

▶ **Conclusion**—AMC spokesmen say that the Rand Corp. of Santa Monica is making extensive studies in connection with all phases of the logistics system. The firm is giving considerable thought to air transportability packaging.

And AMC technicians, on their side, are working closely with industry specialists in the field of packaging and transportation to come up with the best packaging methods and materials available for the job at hand. ■ ■ ■

When the job demands precision

dimensional accuracy

– there's no substitute for MYCALEX® glass-bonded mica insulation

The coil form shown in this RCA-Victor precision tank coil is injection-molded of MYCALEX 410 glass-bonded mica insulation. The coil, operated at approximately 1000 rpm, is subject to high start and stop stresses. The winding contacts a traveling disc and operates at high potential and high frequency. MYCALEX was selected for this application after careful evaluation. The extreme dimensional accuracy, attainable with MYCALEX glass-bonded mica – the unique ceramoplastic – insures perfect contacting and at the same time eliminates balance problems. High dimensional accuracy also affords absolute uniformity of parts, facilitating assembly and replacement. The excellent dielectric properties of MYCALEX insure efficient electrical performance.

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- IMMUNITY TO REPEATED ARCING
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Note: MYCALEX 410 glass-bonded mica, described above, is an exclusive formulation of, and manufactured only by, the Mycalex Corporation of America. It meets all the requirements for Grade L-4B under Joint Army-Navy Specifications JAN-I-10.

For similar economical solutions to your problems, phone or write J. H. DuBois, Vice President-Engineering at the Clifton, N. J. address below.

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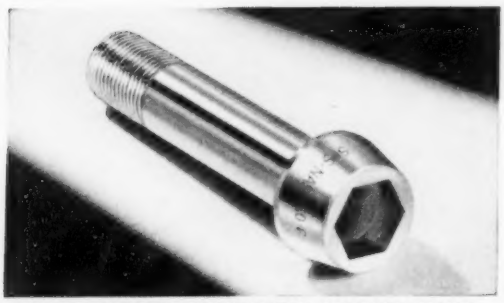


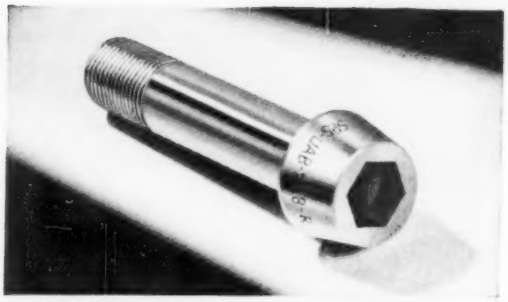
**SPS NAS INTERNAL WRENCHING AIRCRAFT BOLTS**

¼-28 through 1½-12

Procurement Specification NAS 159

Made of aircraft alloy steel—minimum elongation 12%, heat treated to 160,000-180,000 psi tensile. Threads are full formed after heat treatment. All tolerances, unless otherwise specified, ±.010.

Cadmium plated according to Specification QQ-P-416. Supplied undrilled; with drilled head; with drilled shank; or with drilled head and drilled shank.



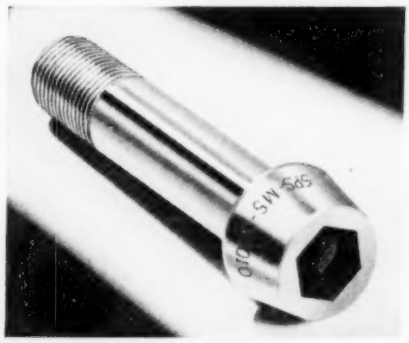
**SPS AIRCRAFT BOLTS—INTERNAL WRENCHING**

¼-28 through 1½-12

Procurement Specification NAS 159

Made of aircraft alloy steel—minimum elongation 12%, heat treated to 160,000-180,000 psi tensile. Threads are fully formed after heat treatment. All tolerances, unless otherwise specified, ±.010.

Cadmium plated according to Specification QQ-P-416. Supplied undrilled; with drilled head; with drilled shank; or with drilled head and drilled shank.



**SPS MS INTERNAL WRENCHING AIRCRAFT BOLTS**

¼-28 through 1½-12

Procurement Specification MIL-B-7838A

Made of aircraft alloy steel—minimum elongation 12%, heat treated to 160,000-180,000 psi tensile. Threads are fully formed after heat treatment, with all head fillets cold worked. All tolerances, unless otherwise specified, ±.010.

Cadmium plated according to specifications. Supplied undrilled or with drilled head.

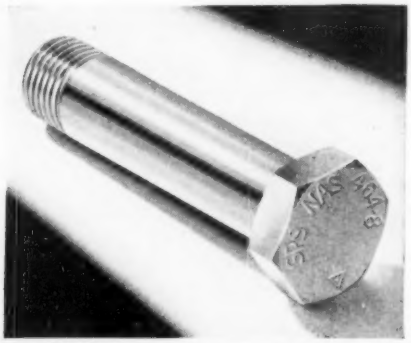
**SPS 12-POINT HIGH TENSION AIRCRAFT BOLTS**

Sizes upon request

Procurement Specifications AMS7452, AMS7472, AMS7478—whichever applies

Made of aircraft alloy steel, or of materials which resist corrosion and high temperatures. Threads fully formed by rolling after heat treatment. All tolerances ±.010, unless otherwise specified.

Plated with cadmium, silver, etc. Supplied with drilled or undrilled head.



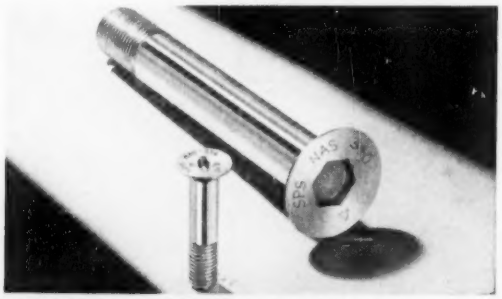
**SPS NAS HEX HEAD EXTERNAL WRENCHING SHEAR BOLTS**

10-32 through 1-14

Procurement Specification NAS 498 or any other specification that may apply

Made of aircraft alloy steel—minimum elongation 12%, heat treated to 160,000-180,000 psi tensile. Threads are fully formed by a rolling process. All tolerances, unless otherwise specified, ±.010.

Cadmium plated according to Specification QQ-P-416. Supplied undrilled or with drilled shank.



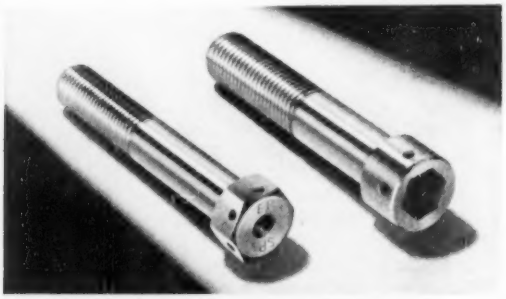
**SPS NAS 100° FLUSH HEAD SHEAR BOLTS**

Hexagon and Phillips Cross Recess

10-32 through ⅝-18

Procurement Specification NAS 498

Made of aircraft alloy steel—minimum elongation 12%, heat treated to 160,000-180,000 psi tensile. Threads are fully formed by a rolling process. Tolerances on linear dimensions ±.010 unless otherwise specified and on angular dimensions ±½°. Cadmium plated according to Specification QQ-P-416. Supplied undrilled or with drilled shank.



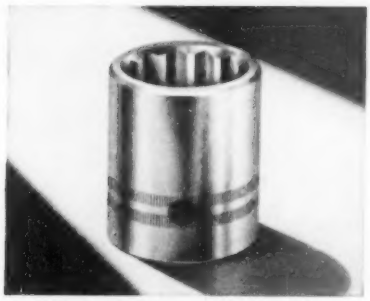
**SPS AN STANDARD SIX-DIGIT ENGINE BOLTS**

Lengths—.375" to 6" in increments of ¼"

Internal Hexagon Socket Type or External Hexagon Head Type

Made of corrosion-resistant steel or aircraft alloy steel in accordance with AMS7452—AMS7472, whichever is applicable. Heat treated to procurement specifications, cadmium plated in accordance with AMS2400. Supplied with drilled head or drilled shank. Linear tolerances, ±.010; angular tolerances, ±2°.

**All SPS bolts can be made from titanium or any of the newer, high temperature alloys.**

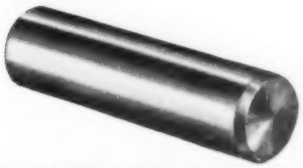


**SPS NAS INTERNAL WRENCHING LOCKNUTS**

¼-28 through 1¼-12

Procurement Specification AN-N-5 except as noted on NAS 443

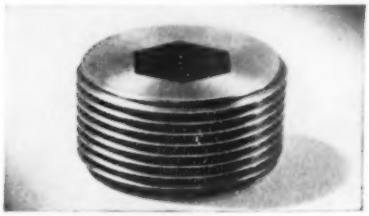
Made of aircraft alloy steel—minimum AMS6280, cadmium plated. They are self-contained units with the positive locking provided by two nonmetallic plugs inserted through the body of the nut and contacting four threads of the bolt. They are suitable for use with NAS Internal Wrenching Bolts or bolts of like thread and heat treatment.



**SPS PRECISION GROUND DOWEL PINS**

⅛ through 1

Made of alloy steel. Formed ends, with continuous grain flow, won't chip. Surface hardness, Rockwell "C" Scale: 60-62. Surface finish: 6 microinch maximum. Core hardness, Rockwell "C" Scale: 50-54. Average single shear strength: 150,000 psi. Diameter tolerance: ±0.0001".

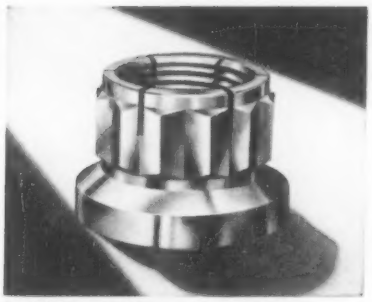


**SPS PRESSURE PLUGS**

¼ through 1¼ ANPT

Procurement Specification MIL-F-5509

Made of heat treated alloy steel, aluminum alloy or magnesium. Threads are fully formed to provide positive sealing without compound. Alloy steel plugs are cadmium plated in accordance with QQ-P-416 or zinc plated in accordance with AN-P-32. Aluminum plugs are anodized. Magnesium plugs are unplated.



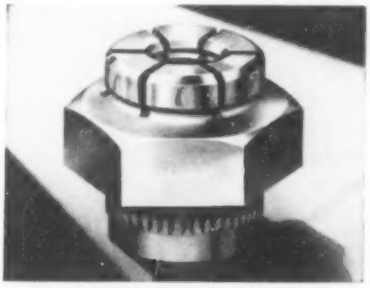
**FLEXLOC EXTERNAL WRENCHING LOCKNUTS**

Style A—¼-28 through ⅝-18

Style B—¾-16 through 1½-12

Procurement Specification AN-N-10a and NAS 353 or any other specification that may apply

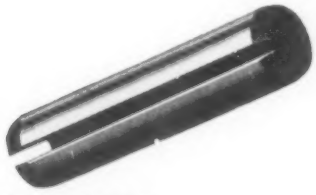
Made of aircraft alloy steel—minimum AMS6280, cadmium plated. They are one-piece, all-metal stop and lock nuts. Positive locking is accomplished by the slotted locking section, which locks on three to four threads of the bolt. Approved to 550°F.



**FLEXLOC SELF-LOCKING CLINCH NUTS**

4-40 through ¼-28

Made of steel, cadmium plated. They are self-contained units incorporating the positive self-locking of regular FLEXLOC locknuts, plus clinching. They are suitable for use on electrical parts and connections, etc.



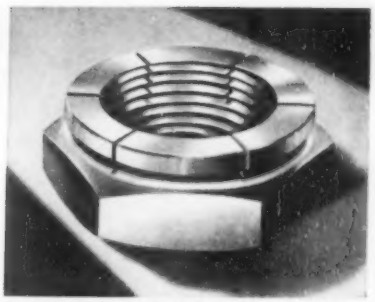
**SPS SPRING PINS**

MS171401 through MS171900

Nominal Diameter—.062 through .500

Procurement Specification AMS7207

Made of AMS5506 corrosion-resistant steel. Surface hardness, Rockwell "C" Scale: 43-52. Also made of heat treated carbon steel—zinc or cadmium plated, or phosphate coated.

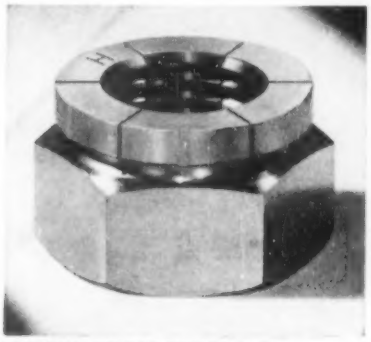


**FLEXLOC SELF-LOCKING NUTS, THIN**

AN-364—6-32 through 1¼-12

Procurement Specifications AN-N-5b and AN-N-10a or any other specification that may apply

AN-364 Nuts—made of steel, cadmium plated—are one-piece, all-metal stop and lock nuts. They are less than regular height, but conform to accepted aircraft standards. Positive locking is accomplished by the slotted locking section, which locks on two to three threads of the bolt. They are designed for temperatures to 550°F.



**FLEXLOC SELF-LOCKING NUTS**

AN-363—6-32 through 1¼-12

AN-363C—6-32 through ¾-16

AN-365—4-40 through 1¼-12

Procurement Specifications AN-N-5b and AN-N-10a or any other specification that may apply

AN-363 and AN-365 Nuts are made of steel, cadmium plated. They are designed for temperatures to 550°F. AN-363C Nuts are made of corrosion resistant steel, silver plated. They are designed for temperatures through 750°F. All are identified by the letter H stamped on the top of the nuts. All are one-piece, all-metal lock and stop nuts of regular AN height. Positive locking is accomplished by the slotted locking section, which locks on three to four threads of the bolt.

AIRCRAFT PRODUCTS DIVISION

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**For complete information about SPS Fasteners for the aircraft industry, write Aircraft Products Division, STANDARD PRESSED STEEL CO., Jenkintown 3, Pa.**

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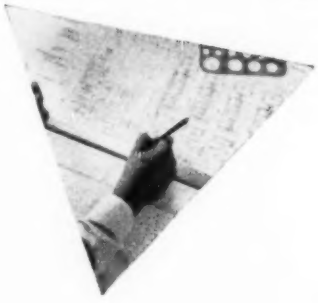
# A Human Life!

**Asset supreme of our democracy and its armed forces; our philosophy of government requires constant search for better means of safeguarding it!**

**By providing devices, not only for direct emergency escape, but more subtly for the cultivation of flight proficiency and component reliability, Stanley Aviation Corporation serves this cause.**



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Developers and primary source for downward ejection seats and automatic escape lap belts. Originators of the full reclining upward ejection seat, a practical emergency escape capsule, and various upward ejection and crew seats.

## TRAINING DEVICES

Pioneer producers of cockpit procedural trainers and helicopter instrument flight trainers. Developers of missile training aids and checkout devices.

## CREATIVE DEVELOPMENT

Founded and nurtured by engineers, this company has maintained an emphasis on development work as inborn policy. Consequently we stand ready to serve in all fields encompassed by the modern weapon system concept.

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**SERVING THE AVIATION INDUSTRY**

**AMC-INDUSTRY TEAMS** keep Boeing B-47 Stratojet bombers flowing out of factories in three states to join Strategic Air Command.

■ PRODUCTION

# Aircraft Program Geared to USAF Goal

**Air Materiel Command and the aircraft industry are engaged in the largest peacetime production program in history. It is aimed at the twin goals of expanding USAF combat strength to 137 wings and modernizing the active inventory of more than 20,000 aircraft. This program has expanded the aircraft industry until it is now the largest single employer in the manufacturing field, with 750,000 people directly employed and well over a million more people working for its subcontractors and suppliers.**

**To supervise this vast effort by the industry charged with developing and building new equipment for the expanded and modernized USAF, Air Materiel Command has had to streamline its procedures and develop new methods for swift liaison between its centralized controls at headquarters, decentralized operations in the field and the industrial organizations with which it works.**

**Key to these new methods is the growing importance of the Air Materiel Area and the recognition of the need to establish fast, clear and decisive channels of communication between AMC and the aircraft industry.**

**AMC's job of production supervision is further complicated by the growing complexity of aerial weapons systems which have advanced and improved to such an extent that they require the addition of many new industrial skills to the traditional scope of the aircraft industry.**

**AMC is also fighting the battle against rising wages and material costs to get more Air Force equipment out of a limited budget. Development of better production methods for industry such as the heavy press program play an important role in cutting production costs.**

**While deeply enmeshed in the problems of current production, AMC is also charged with responsibility for developing plans and techniques to meet future industrial mobilization requirements in the event USAF is again called on to meet a full-scale national emergency.**

■ PRODUCTION

# How an AMA Speeds Weapon Production

By Irving Stone

**Wichita—The modern arcial weapon, replete with myriad details of structure, powerplant, armament, equipment, and mechanical and avionic controls, poses a tremendous challenge to military planners and civil constructors and to administrators in both categories.**

**Involved is a mass of problems concerned with facilities, tools, production schedules, engineering changes, interchangeability, spares, modifications, and cycle maintenance. These are but a few of the sources of difficulty.**

In the resolution of these problems through efficient coordination with the aircraft industry, the Air Materiel Command and its lower echelons play an indispensable role.

▶ **B-47 Teamwork**—One example of this teamwork is the B-47 program, the largest single USAF postwar aircraft production job, requiring well-coordinated work of an AMC Air Materiel Area and three aircraft manufacturers. Other aircraft programs offer similiar examples of teamwork, the biggest difference being the size and scope of B-47 program, that required a special Production Committee, a coordinating group representing the three prime contractors (Boeing, Douglas and Lockheed) and the AMC.

The original Boeing contract in September 1948 was for 10 B-47As. Later, the administration of this contract was taken over by the Joint Project Office set up by AMC and the Air Research and Development Command at Dayton to streamline the development and procurement of a given type of aircraft. The Joint Project concept came about when ARDC, the old engineering division of AMC setup.

Maj. Robert E. Moore is now the AMC chief of the B-47 project and his WADC counterpart is Lt. Col. R. C. Kuhn.

ARDC retained engineering responsibility for all engineering development on the planes, while the responsibility for procurement fell to AMC. The overlapping, or gray, areas of procurement and engineering is one of the basic reasons for the establishment of the Joint Project Office.

Assuming that the test program for the initial quantity of planes essentially meets all requirements, an additional procurement against military needs for that particular plane is initiated. This is in the form of a production contract—for the B-47 it was in November 1949. The contract also provides for the continued development and improvement of the basic plane.

The number of planes involved in the contract and the mission of the using Command receiving the planes (Strategic Command for the B-47) are tailored to the responsibilities of the Air Force, which is dependent upon the general situation at that time.

The administration of the large-scale B-47 production contracts has been delegated to other echelons within AMC. These echelons are primarily the Air Materiel Areas (AMAs) and the local AF plant representatives (working out of the Air Materiel Areas) stationed at the contractors' facilities.

▶ **Role of AMA**—The AMAs are established with prime cognizance (surveillance responsibility for procurement) of particular planes (regardless of geographical areas where fabricated), accessories, and AF support equipment (tow tractors, starter-generator units, special tools for maintenance, etc.).

In the case of the B-47 and other Boeing planes, the Oklahoma City Air Materiel Area (OCAMA), commanded by Maj. Gen. W. O. Senter, has prime cognizance. OCAMA also has responsibility for procurement of spare parts for the B-47 program (determinations are sent to the plant representative for administration), support of the plane in the field, and administrative responsibility for the subordinate units such as the plant representative's offices and air procurement district in that area.

▶ **Plant Rep's Office**—The plant rep's office receives policy guidance on all phases of procurement, production and inspection functions through OCAMA from ANC headquarters.

OCAMA also has counterparts of all the divisional activities within the plant rep's office, to perform surveillance, determine operating policies and furnish actual physical assistance to the plant rep's division when necessary.

The plant rep's office exercises administrative control of all contracts assigned

**B-47 TAKES OFF** using additional thrust from Rato rack and water injection. Rocket units are dropped to lose dead weight.

to the particular contractor (Boeing, Lockheed, or Douglas, as the case may be). This control is split into various divisional activities—those dealing with contractual matters, production of aircraft, flight testing of production and experimental aircraft, quality control (inspection), facilities necessary to support the production program and property accountability.

The opposite numbers of these functions may be represented also in the contractor's organization which, of course, has the prime responsibility for building the airplane.

## Production Division

The plant rep's production division is a coordinating and expediting activity to insure delivery of aircraft on schedule. It accomplishes its responsibilities with cooperation from other segments of the AMC procurement system and the contractor. Some of the activities of the production division include:

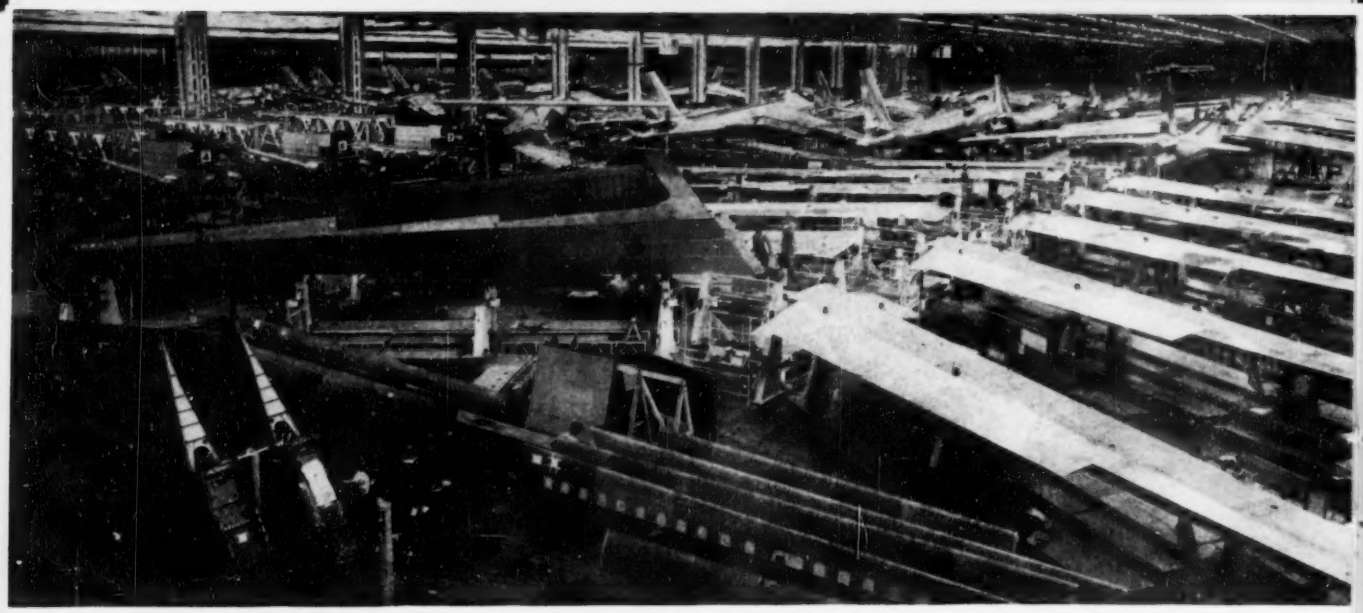
- **Coordination of contractor's** schedule requirements with Weapons System Project Office for government furnished aircraft equipment (GFAE) such as engines, radio and radar gear, landing gear, and instruments. These are items over which the contractor has no control and are bought collectively by the government for the sake of greater economy.
- **Discussions with the contractor** and recommendations to higher headquarters of the necessity for additional facilities, such as machine tools, factory and office buildings, ramp space, etc., to produce the plane according to the schedule established.
- **Expediting the solution** of technical problems which inevitably develop in

**B-47 PRODUCTION COMMITTEE** (l to r): Douglas Aircraft's Sebring, Lockheed Aircraft's Hollowell, AMC's Lt. Col. Disher, Boeing Airplane's Bourland.

**RATO RACK,** a modification, gives B-47 33,000 lb. added thrust at takeoff.

**WATER INJECTION,** standard on new B-47s, aids takeoff.

**OLDER METHOD** uses 18 internal Rato units.



**BOEING'S WICHITA DIVISION** production floor is loaded with huge components going into fast, six-jet B-47 Stratojet bomber.

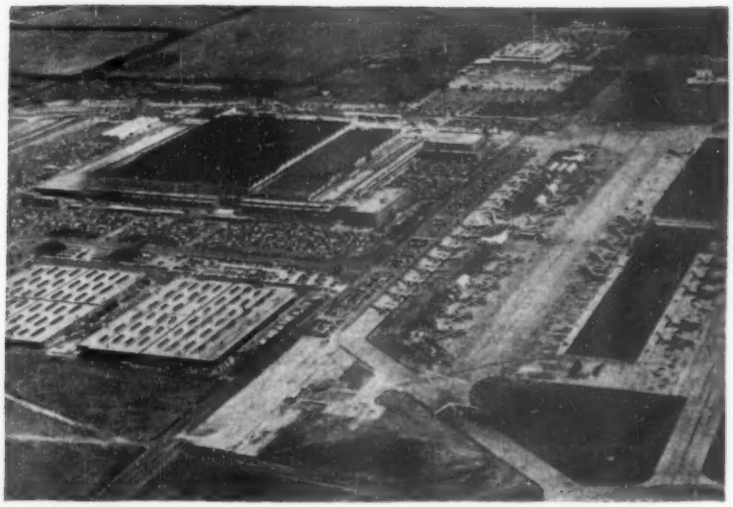
building complex modern aircraft. This effort usually involves any or all of the contractor's production, quality control and engineering sections, the responsible AMA (in this case OCAMA), and the Weapons System Project Office at AMC headquarters (which includes elements of ARDC).

• **Insuring timely production** of spare parts for concurrent support of planes which have been delivered to the combat wings.

## Quality Control

The plant rep's quality control division conducts continuous inspection from individual parts to the completed

**DOUGLAS' TULSA PLANT** shows busy final assembly line (below) for B-47. View above reveals 5,000-ft.-long main building.



**AERIAL VIEW** of Wichita facility shows part of Boeing's 446 acres here.

plane. Its responsibilities also include approval of the contractor's inspection system.

Primary purpose of quality control division is to insure compliance with the specifications governing the construction of the plane, and to insure that the aircraft are complete in every respect upon delivery.

The AF inspection stamp on the plane is the green light for delivery of, and payment for, the plane. Thus, quality control, in effect, accepts the plane or spare parts for the government.

The flight test and acceptance division has the responsibility of flying each production plane for functional testing the basic article and each of its systems in flight.

This is done to insure that the plane is capable of performing its mission as described by the specifications governing its flight characteristics. In addition, this division monitors the contractor's ARDC-planned experimental flight test programs, which include tests of plane characteristics as well as checks on system developments.

## Contract Division

The contract division discharges that part of the plant rep's responsibilities which pertain to contracts with the particular constructor. The division's functions include:

• **Approval of expenditure** of obligated funds for facility construction.

## ■PRODUCTION

• **Authorization for payment** of invoices for delivered products and partial payment to be made during the production period.

• **Approval of requests** by contractor for overtime in order to prevent production bottlenecks.

• **Participation** in Hq., AMC, negotiations with contractor; recommendations to higher headquarters (OCAMA and AMC) for changes to existing contracts to accommodate the changes in the production program.

• **Participation in price** determinations and negotiations on completed or terminated contracts.

In addition to the above divisional activities, there are other support functions within the plant rep's office, such as security, traffic, operations and property administration.

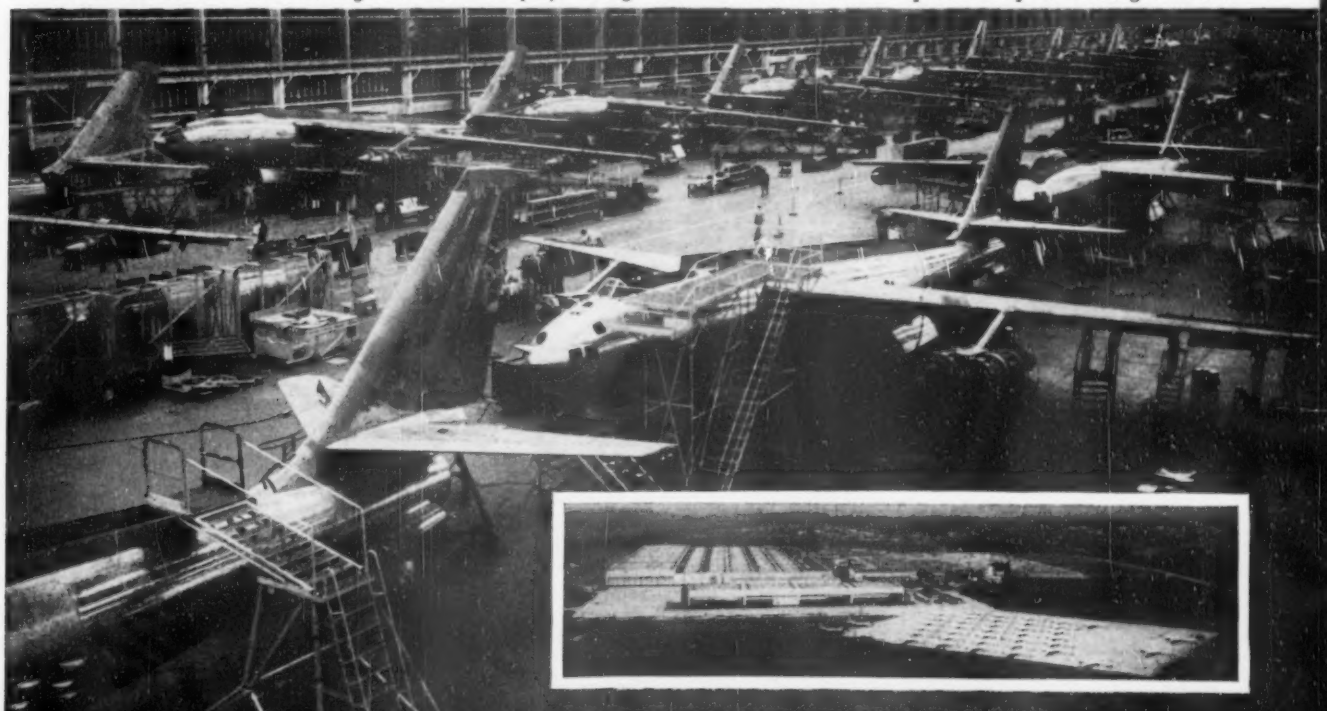
There are always situations arising which require close cooperation between ARDC, AMC, the tactical commands OCAMA and the plant rep and the B-47 contractors (Boeing, Lockheed and Douglas).

▶ **Field Difficulties**—Many difficulties arise with respect to operation of planes in the field, which may involve educational factors in operational procedures and, sometimes, deficiencies in equipment.

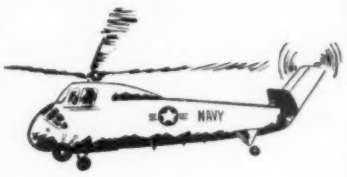
In many cases, either type of difficulty is solved by OCAMA calling on the contractor to furnish representatives to work directly with the using agencies or in conjunction with OCAMA personnel who constantly work with this type of problem.

Contractors usually are more than willing to see that the using agency gets the best operational service from

**LOCKHEED-BUILT** B-47s roll along final line in company's Georgia division. Inset shows main production plant covering 45 acres.



# Why do most types of 'copters fly with Lycoming-built engines?



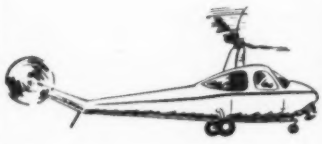

*Lycoming-powered* Sikorsky S-58 Anti-Submarine 'Copter*

*Lycoming-powered* Piasecki H-21 Matériel and Troop Transport*

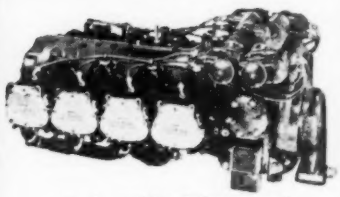
*Lycoming-powered Kaman HTK-1 Military Trainer*

*Lycoming-powered Doman L-Z5 General Utility 'Copter*

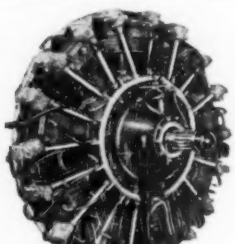
*Lycoming-powered Brantly Model B-2 Personal 2-place 'Copter*



*Lycoming-powered Glenview FlyRide Personal 2-place 'Copter*



*4-, 6-, and 8-cylinder opposed air-cooled engines.*



*7- and 9-cylinder radial air-cooled engines.**

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**Still "under wraps," being developed for the Military. Lycoming's new "pioneers" that promise greater efficiency, greater economy, more brilliant performance than any helicopter engines ever before developed.**

*Wright-Cyclone engine, built by Lycoming under license from Curtiss-Wright Corporation, Wright Aeronautical Division.

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Manufacturing plants in Stratford, Conn. and Williamsport, Pa.

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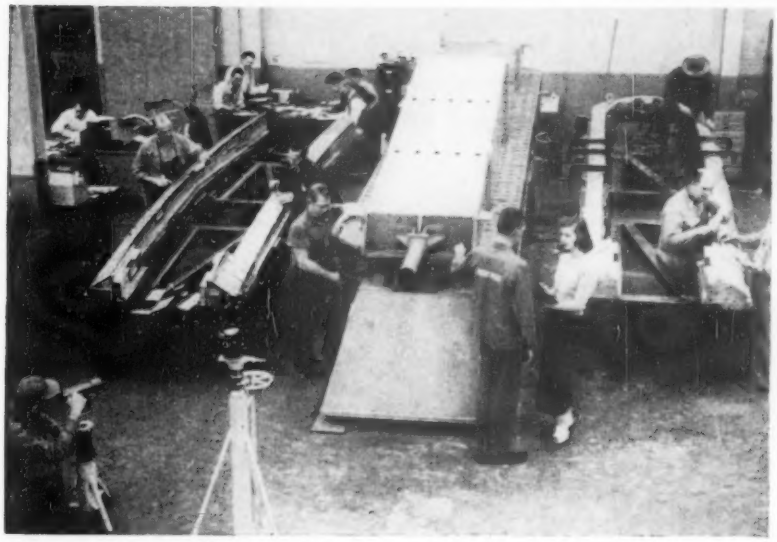
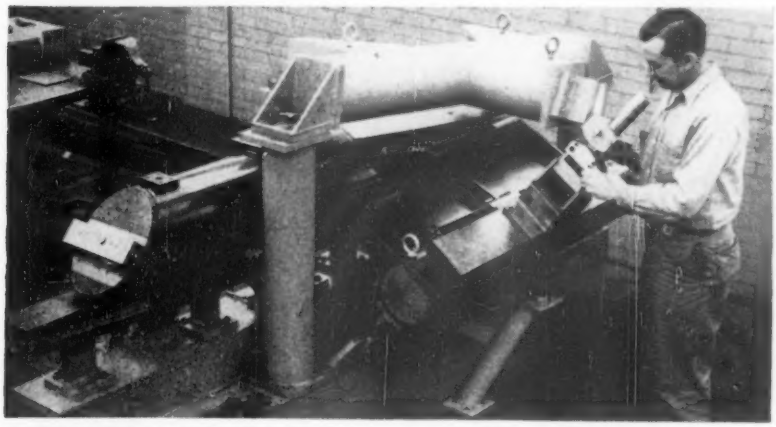


**MASTER GAGE SHOP** at Boeing, Wichita, where masters have been made for B-47 production at Douglas, Lockheed. Control gage is in center, master at each side.



**MASTER GAGE** for fuel tank drop strut shown in control gage (light gray parts).

the product. At large operating establishments, contractor's reps may, in many cases, be permanently stationed as field representatives. These men may be supplemented by others, through OCAMA's request, to clear up any emergency situations.

▶ **Unsatisfactory Reports**—Another situation involving close cooperation is the processing of unsatisfactory reports (URs) for ultimate improvement of the product. All URs are submitted on a worldwide basis by the using activities (B-47s and other Boeing aircraft except B-17s to OCAMA), which screens these reports for project action. The URs fall into one or more of the following general project categories—engineering changes, quality control, or maintenance.

• **Engineering changes** are generally those which affect the weight of the aircraft or modifies a component.

• **Quality control** deals with defects resulting from improper inspection at the contractor's plant or at a depot.

• **Maintenance** pertains to improper procedures contained in the applicable technical order (TO). These may stem from erroneous information or incomplete instructions for performing maintenance in the field.

If the UR anticipates an engineering change, follow-up is made to Wright Air Development Center or the contractor (depending upon the nature of the change) for comment. Engineering change proposals (ECPs) originate from the contractor's plant, on request of Weapons System Project Office.

OCAMA evaluates the ECP for retrofit (modification) action with respect to aircraft already in service. WADC evaluates the ECP concurrently with OCAMA and forwards its comments to the latter.

Quality control URs are forwarded to the affected agency—the contractor or

as others see us . . .

A user tells how AETCO SERVICE helped him

JOHN STAMBAUGH
*President*
PreReg Manufacturing Inc.

"I want you to know how much we appreciate your very fine cooperation in testing so quickly and thoroughly the PreReg Switch sent you recently. You will recall that we put you on the spot as far as the time element was concerned, yet your outfit came through on schedule with a complete report prepared in accordance with the requirements of four sets of specifications—MIL-E-5272, MIL-P-5518, MIL-M-7911 and USAF41065B.

"The completeness of your report not only confirmed our belief in the all-around high quality of the PreReg Pressure Switch, but should certainly anticipate any questions likely to occur to designers and engineers interested in applying the unit to their problems.

"It was a pleasure to work with you, and I look forward to continuing relationship as my new business grows."

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such Magnificence . . . such Power
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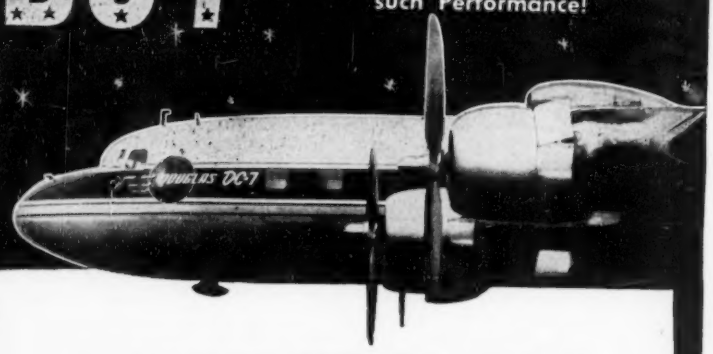


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In the never-ending conquest of the vast barriers of space and time, Douglas goes ever forward meeting every challenge that men and machines must face. The newest — and brightest — star in the aviation firmament, the Douglas DC-7, is truly a miracle of the mastery of men over machines . . . and in this great work sixteen A. W. Haydon timing devices play an important part.

We at A. W. Haydon take pride in our contribution toward bringing a mass of metal and machinery into integrated performance which meets Douglas' high standards. Integrated performance is born of a multitude of small component parts, working in perfect mechanical and electrical coordination. The A. W. Haydon precision timing instruments are a vital part of this vast network.

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DOUGLAS DC-7, the ultimate in comfortable and safe air travel. Swift, luxurious, dependable — the new DOUGLAS DC-7 justly deserves the accolades it is receiving.

✓ A. W. Haydon Time Delay Relay is a very important component of the automatic prop feathering system.

✓ A. W. Haydon Time Delay Relay times duration of prop feathering.

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When timing poses a problem — consult

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Design and Manufacture of Electro-Mechanical Timing Devices

**MODIFICATION** program brought armament improvement to Stratojet. General Electric-designed, radar-controlled 20-mm.-cannon tail turret is standard on B-47E and RB-47E (reconnaissance version).

the depot—for comments with respect to action for correcting the deficiency.

Maintenance URs are handled at OCAMA. Technical orders involved are revised or supplemented to correct the unsatisfactory condition. These revisions and additions are forwarded to the using agency, also are entered in the basic handbook periodically by the contractor.

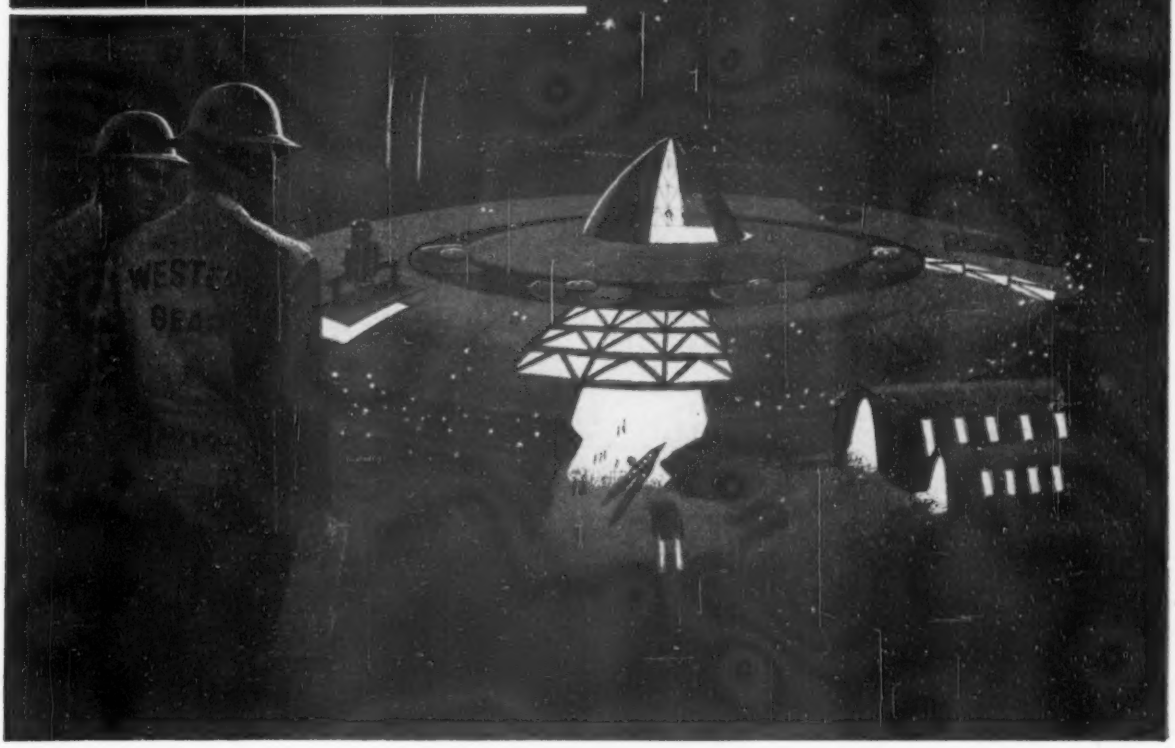
OCAMA generates and maintains statistical charts depicting all deficiencies related to URs. These charts show the particular deficiency areas requiring attention to maintain the aircraft effectively.

They also show what installations or systems are giving the most trouble and what the trend is in the operation of the particular installation or system.

▶ **Retrofit Program**—Another example of how OCAMA and the airplane contractor cooperate is the B-47 retrofit (modification) program.

OCAMA's responsibility for retrofit is to determine the feasibility of accomplishing desired changes and improvements on planes already produced. These changes, for example, may concern a group of B-47Bs which are being considered for modification to a later configuration. Consideration of these changes is coordinated between OCAMA, AMC Hq., ARDC, and the using agency—SAC or Air Training Command. The object of modifications is to bring the flying article to its ultimate technical capability in keeping with its mission. In short, modifications

# GEAR DRIVES for SPACE STATION



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Perhaps not; but when interplanetary travel becomes possible you can bet that Western Gear Works' research, engineering and manufacturing skills will have contributed mightily to such progress. Our company has paced the growth of flight from its early days, designing and building mechanical and electrical power transmission drives for the multitude of needs of equipment operation and aircraft control. We believe we have designed and manufactured more actuators and accessory drives than any similar company, for there is scarcely an aircraft today that does not have one or more Western Gear products aboard.

**HERE'S WHAT THIS MEANS TO YOU:** All problems of transmitting motion or torque aboard any type of airborne craft can be completely entrusted to Western Gear Works' engineers with full assurance that it will result in the most practical and efficient design at a proper price. Why not avail yourself now of this unusually complete service?

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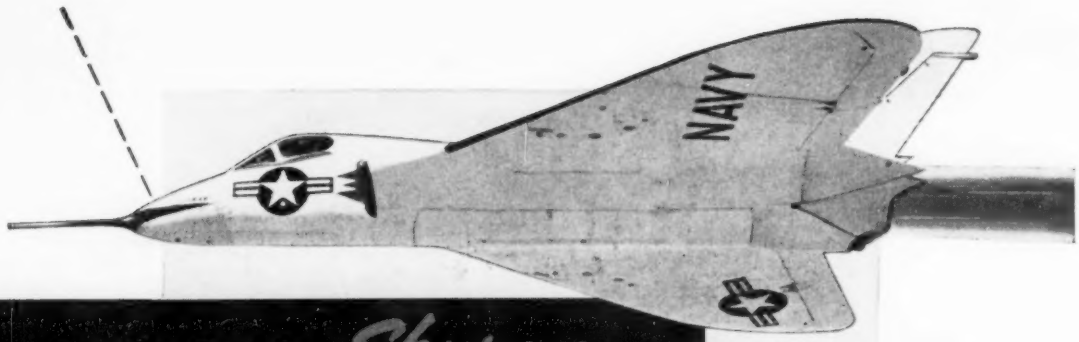


Douglas F4D Skyray, equipped with South Wind Model 936-A Oil Cooler

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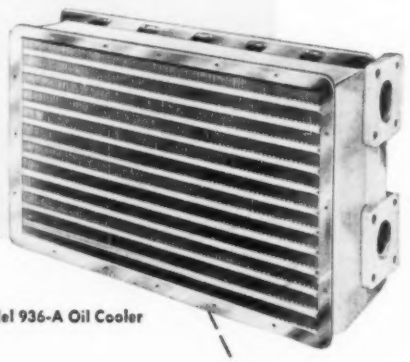
# heat exchangers

This South Wind Oil Cooler was chosen for the fabulous Douglas Skyray. It is but one of many heat exchangers developed by South Wind to meet the challenge of higher temperatures in advanced jet engines. These heat exchangers fully comply with the rigid specifications set up by airframe and engine manufacturers, as well as the makers of air cycle cooling packages.

### Stainless Steel or Aluminum— To Meet Your Specific Design Needs

South Wind is now designing and fabricating lightweight, thinwall heat exchangers in both stainless steel and aluminum for many different applications. The new heat exchangers are available with either the tube bundle or the plate and fin type of design . . . whichever the job requires.

Air-to-air, liquid-to-liquid, or air-to-liquid—whatever your need in heat transfer equipment—South Wind's experienced engineering staff will be glad to consult with you. For information, write Stewart-Warner Corp., South Wind Division, 1514 Drover St., Indianapolis 7, Ind.



Model 936-A Oil Cooler

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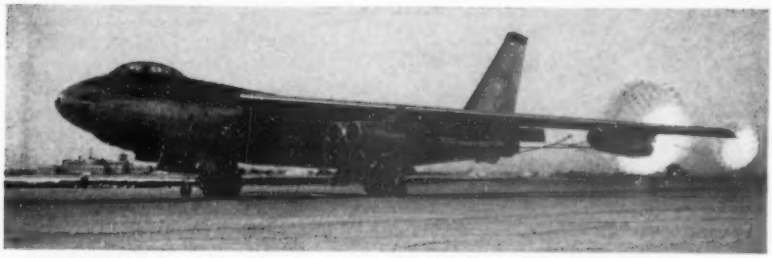
**INERT GAS GENERATORS**



**APPROACH CHUTE,** 16-ft.-diameter unit (right) also is modification addition.

**MODIFICATION JOBS** done outdoors in "doghouses" save space at Boeing plant.

**UNIT HANGARS** at Douglas house B-47s for modifications, cycle maintenance.

are an attempt to stay current in the field of progress.

All such changes are tightly programmed by Hq., USAF, through ARDC and AMC to the field.

▶ **Does It Pay?**—Following through on the retrofit job, OCAMA holds preliminary discussions with the prime contractor to determine immediate views on the feasibility of the various modification items. Following this discussion, the contractor—Boeing, for example—proceeds with a cost and time proposal, which is presented to OCAMA and ARDC for final review. This review weighs urgency of modification against time and cost data.

After this, OCAMA makes recommendations to AMC which, in turn, goes to USAF headquarters for establishment of the requirement. On approval, modification program is initiated.

The retrofit work might be done at one or more of the three prime contractors—Boeing, Douglas, or Lockheed—or even at Tinker AFB. If the work is done at a location other than Boeing, then the latter would supply only the technical data, and the cost and time information would come from the modifier.

Modification kits could be supplied by any of the three primes, or by a subcontractor, if OCAMA approves.

▶ **B-47 Modifications**—Some of these modifications have involved:

• **Water injection** to obtain improved takeoff performance through thrust augmentation. Water injection could supplement or eliminate rocket assisted takeoff, depending upon takeoff conditions.

• **Increase in takeoff gross weight,** involving structural beef-up and additional plies for tires.

• **Installation of electronic equipment**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+ These subminiature relays (exact size shown) are hermetically sealed, designed to meet, and in some respects exceed, the requirements of Military Specification MIL-R-5757B. They are thoroughly degassed and nitrogen filled at a pressure of one atmosphere.

Having a diameter of 1" and a case length of 1-5/16", the 6-pole relay is by far the most compact unit available. Ten relays occupy only ten square inches of chassis space (using the "SB" or "SC" type mounting), which is the answer to the problem of subminiaturization.

Compactly and ruggedly constructed, the relay is actuated by a precision built rotary motor of entirely new and proven design having, in addition to high shock resistance, a high torque factor to weight and size ratio.

The active rotary motor parts are precisely machined and gas annealed under exacting conditions which results in a product which is superior to one made of stamped parts.

Tests of production relays, under USAF supervision, have proven that they exceed the requirement of MIL-R-5757B by an ample margin in some respects.

The relays are also available in four-pole, three-pole and two-pole double-throw. A plug-in version is also available.

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*Please send data sheets on your subminiature relays.*

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required for various missions.

• **Improvements** concerned with defensive armament, bombing system, radio communications equipment, autopilot system, and accessibility to various electronic components.

The local plant rep's office is responsible for checking the work and for the flight acceptance of modification jobs, much the same as it checks production jobs and does flight test acceptance on those planes.

The contractor's personnel does its own inspection and flight tests before these jobs are performed by the plant rep's office.

▶ **Cycle Maintenance**—Keying modifications with cycle maintenance is another instance where OCAMA works closely with industry.

When B-47s come in from the field for cycle maintenance (roughly, about every two years) to any one of the three prime contractors or Tinker AFB, OCAMA may specify that this maintenance shall include specific modifications to be done concurrently with the maintenance work. OCAMA would specify these concurrent modifications only within Hq., USAF-controlled programs and after consultation with SAC, other commands and the contractor. The latter would be consulted for opinions on time factors and availability of parts.

▶ **Years' Notice**—Notice of this modification work to be done concurrently with cycle maintenance may be given as much as several years in advance so that plans can be made accordingly—kits prepared and reasonable schedules set up.

When the program for cycle maintenance of the B-47 was in its developmental inception, OCAMA foresaw the advantage of having Boeing and other contractor personnel obtain basic familiarization with Convair's SAM-SAC (Special Aircraft Maintenance-Strategic Air Command) program for modernization and cycle maintenance of the B-36.

These contractor representatives visited San Antonio and Fort Worth for this information. Boeing personnel on their own also visited airline maintenance operations both on the East and West Coasts, and also visited West Coast Air Force maintenance contractors (North American Aviation and Douglas).

After these initial visits, additional personnel were sent out for more specific orientation. Boeing feels that this orientation data has been very helpful. Boeing's observations have been passed on to OCAMA and is helping to develop an OCAMA program for most benefit to SAC—it has helped in the sequencing of planes for modifications and the degree of modification introduced to build up an efficient learning curve so that SAC can get "the most

IS THE DATA VALID?

The moment an oscillograph is taken out of the laboratory for aircraft flight testing, vehicle road tests, or any application where vibration and dynamic g forces are present, the "balance" of its galvanometers—the measure of their response to gravitational force—becomes all-important. An unbalanced galvanometer can cause deflections—under only moderate g-loadings—large enough to distort a data trace and make accurate record interpretation impossible. It can show deflections even when no data signal is present.

Miller Instruments' *improved* galvanometers are supplied *at no extra cost* with balance so closely controlled that trace deflection is within 0.010" per g in elements of less than 300 cps natural frequency and within 0.001" per g for higher frequencies. The unique open construction allows balancing to be the *final* operation before shipment. No subsequent assembly steps disturb the balance achieved. Trace deflection due to g forces displacing the suspension is negligible.

Sound basic concept and extreme care in manufacturing and testing make Miller Galvanometers unequalled not only in their balance but also in their control of sensitivity, linearity and stability. Inaccuracies have been literally "designed out." The unusual fineness of the traces they produce have long been the standard in oscillographic recording. Available with natural frequencies from 35 to 3200 cps and a wide range of sensitivities, Miller Galvanometers are described in detailed literature, which will be sent on request.

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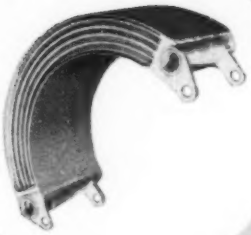
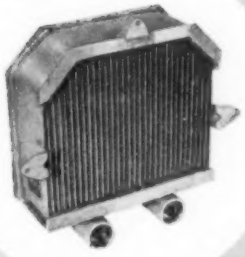


# paralyzing temperatures *exchanged for* operating temperatures



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**Flow control is a valve function. The capacity to exchange heat is the responsibility of the heat exchanger, and heat exchanger efficiency depends upon its ability to meet given space and weight limits with minimum power consumption.**

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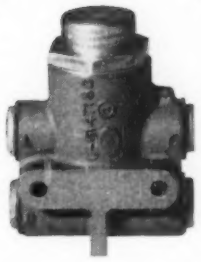

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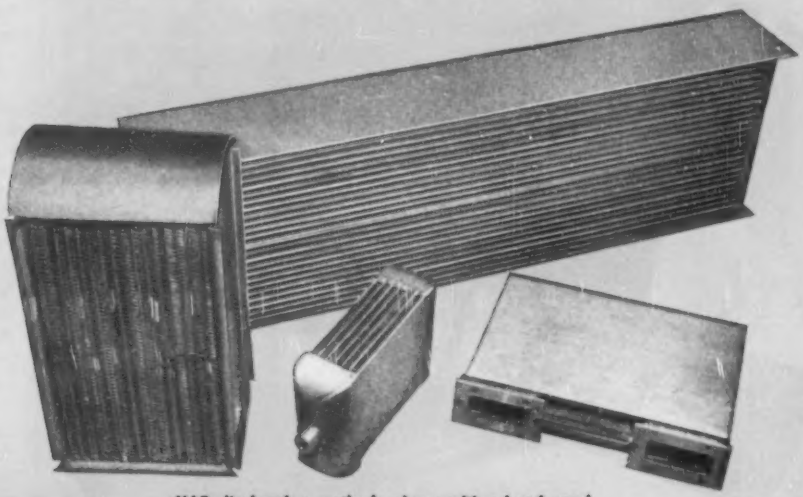

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Servomechanisms, Inc. Type 17ID, for use with the amplifier, is a damped-control motor whose control winding is the output load for the amplifier.

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West Coast Division, 316 Washington Street, El Segundo, California




airplane" in the shortest time.

Provisioning of spare parts, machine tool acquisition and facilities construction are other areas where OCAMA lends close support to a program such as that of the B-47.

▶**Provisioning of Spares**—Formerly, when OCAMA had not yet participated in the B-47 program, spares for the planes were provisioned by the contractor after consultation with AMC supply and maintenance representatives regarding type and quantity of items required.

These items might include everything that the Air Force might need to maintain the plane in accordance with its operational plans. Accordingly, these items could include landing gear, flaps, rudders, ailerons, and various bits and pieces for repair. Government furnished aircraft equipment would not be included.

This direct AMC contact has been altered since OCAMA came into the picture under AMC's decentralization policy.

Now, policy guidance and final approval rests with AMC, but OCAMA requests recommended quantities and budget prices for spares under a new contract. A contractor such as Boeing supplies this data and OCAMA reconciles the information with requirements of their prime depots. The order to Boeing, Douglas or Lockheed then follows. The contractor either manufactures these spares or procures them from a subcontractor for shipment.

This arrangement is a new development on which OCAMA and Boeing are working together. The procedure is still in the process of refinement.

▶**Getting Machine Tools**—With respect to machine tools for a new (anticipated) contract or a new model of an existing plane, such as the B-47, the contractor surveys its present machine tool capacity, decides what new tools it will require, and submits an Appendix A (a list and cost) to OCAMA for transmission to AMC for budget planning purposes.

Upon notification of the plane contract award, the contractor submits a complete justification for the individual machine tools. This list is approved by the local contracting officer as to necessity. After this the list is screened against Air Force reserve equipment (surplus plant items and national pool items) and procured where possible from this source.

Those items which cannot be filled from this source are obtained by the contractor under AF authority.

On new construction, an OCAMA representative reviews, from a technical standpoint, the contractor's plans and specifications for the facilities. Approved items go through OCAMA to AMC for

**OCAMA COMMANDER,** Maj. Gen. W. O. Senter, discusses job with foundrymen at Lockheed's Marietta, Ga., plant, where B-47s are built under OCAMA jurisdiction.

final approval and authorization for the contractor to proceed with construction of facilities.

## Weapons Phasing Group

Both OCAMA and the plant rep participate in the B-47 Weapons Phasing Group meeting. These are held periodically, from 30 to 60 days apart, and include representatives from the contractors (Boeing, Lockheed and Douglas), ARDC, SAC, Air Training Command, and the B-47 Production Committee.

The AMC representative of the Weapons System Project office (AMC and ARDC) serves as chairman of the meeting.

Purpose of the Weapons Phasing Group is to present mutually problems of operations (daily flying), logistics support, training, and application of proposed changes on a production basis and/or retrofit.

## Heavy Press Program

A far-reaching example of foresight and cooperation on the part of AMC is the heavy press program it is directing (AVIATION WEEK, Mar. 2, 1953, p. 98).

▶**Benefits to Come**—Airframe and engine manufacturers will benefit tremendously from the larger, "more precise" parts to become available with the operation of the huge presses involved in the program.

Latest experience with the Air Force 18,000-ton forge press at Wyman-Gordon, Worcester, Mass. (which pioneered heavy forge work in this country), and the 16,500-ton unit at Aluminum Co. of America, Cleveland, are showing what benefits may be derived from the new presses scheduled for operation soon. Parts from the 18,000-ton press long have been incorporated


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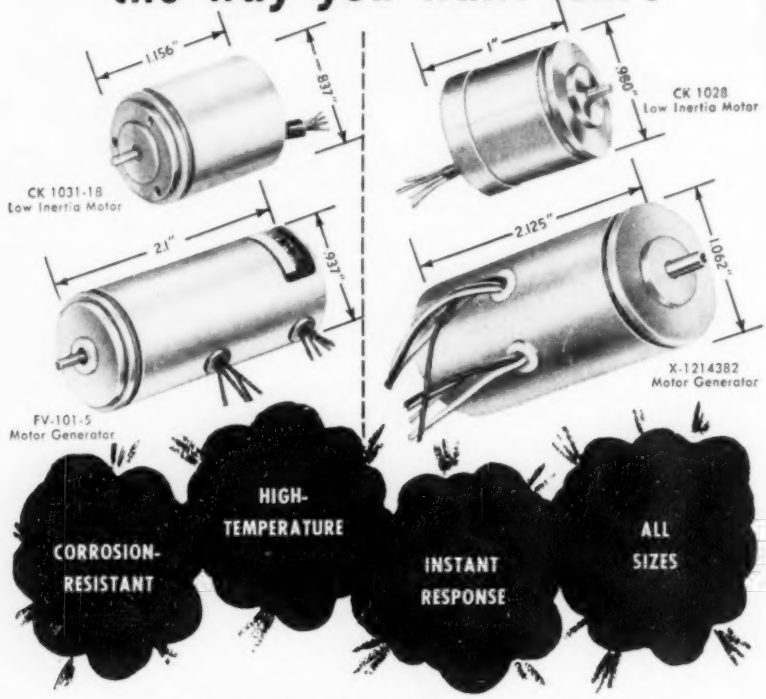


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TYPICAL CHARACTERISTICS

| Type Number | Rated Voltage | | Max. Power Input Total (Watts) | No Load Speed (RPM) | Stall Torque (oz. inches) | Torque to Inertia Ratio (Radians per Sec.²) | Weight (oz.) |
|---|---|---|---|---|---|---|---|
| | Phase 1 | Phase 2 | | | | | |
| **LOW INERTIA MOTORS** | | | | | | | |
| CK-1018-7 | 18 | 18 | 5 | 10,000 | 0.13 | 13,000 | 1.6 |
| CK-1022-13 | 115 | 115/57.5 | 12 | 4,800 | 1.45 | 33,800 | 8.0 |
| CK-1027-14 | 115 | 115/57.5 | 7 | 6,200 | 0.63 | 41,500 | 4.5 |
| CK-1028-16 | 26 | 26 | 6 | 10,000 | 0.28 | 13,000 | 1.6 |
| CK-1031-18 | 26 | 55 | 9 | 6,400 | 0.35 | 10,000 | 2.2 |
| CK-2006-1 | 64 | 64 | 30 | 7,200 | 2.6 | 70,000 | 10.0 |
| CK-3000-1 | 110 | 220 | 80 | 3,700 | 14.0 | 3,750 | 30.0 |
| **MOTOR GENERATORS** | | | | | | | |
| FV-101-5 | 26 | 26 | 9.5 | 10,000 | 0.28 | 10,000 | 2.9 |
| FV-2001-2 | 115 | 115 | 30 | 6,600 | 3.0 | 70,000 | 12.6 |
| FV-3000-1 | 110 | 220 | 80 | 3,700 | 14.0 | 3,750 | 30.0 |
| X-1214382 | 26 | 26 | 9.7 | 6,000 | 2.6 | 21,000 | 5.5 |

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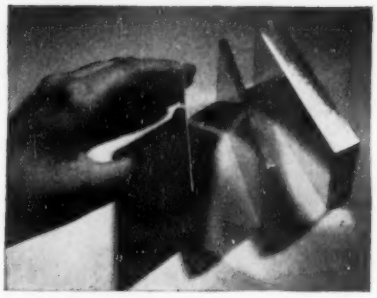

**TAPERED SHEET** for B-47, with root thickness of ⅝ in. (right) and ⅛ in. at tip (center), is product of AMC-sponsored rolling mill. By contrast, heaviest wing skin on B-29 is ⅜ in.; on B-17, it is approximately ½ in. (left).

in the B-47, B-52 and other planes.

Now being forged on an experimental basis are four (two Wyman-Gordon and two Alcoa) parts which indicate clearly the design techniques which will ultimately be available from the larger presses.

One of these developmental forgings is produced with no draft. On the new developmental parts, new tolerances achieved will mean that machining will be as little as one-tenth of that previously required.

Industry observers state that "precision" forgings may be developed to the point where it will only be necessary to machine such surfaces as bosses.

►**Tapered Mill**—Another outstanding example of AMC-sponsored facilities is a huge tapered sheet and plate rolling mill operated by Alcoa at Davenport, Iowa (AVIATION WEEK June 28, p. 54). The rolling mill and some auxiliary equipment has been supplied to Alcoa under a lease arrangement with AF.

From this mill, Alcoa supplies tapered sheet for the B-47, the material ranging from ⅝ in. at the wing root to ⅛ in. at the tip.

This tapered material saves large amounts of milling machine time, scrap, space and inventory—vital factors in a production program.

Other equipment being installed at Alcoa under lease arrangement with the Air Force includes a large milling machine capable of machining 10x40-ft. plates and a 7x40-ft. taper grinder. This equipment will enable meeting production requirements for longitudinally tapered material with multiple tapers and material with transverse tapers.

## Production Committee

One of the important activities in the Stratojet program is the B-47 Production Committee. Generally, the committee's primary interest with respect to the B-47 program is to coordinate the production phase between

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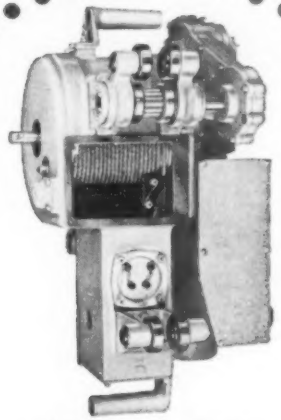

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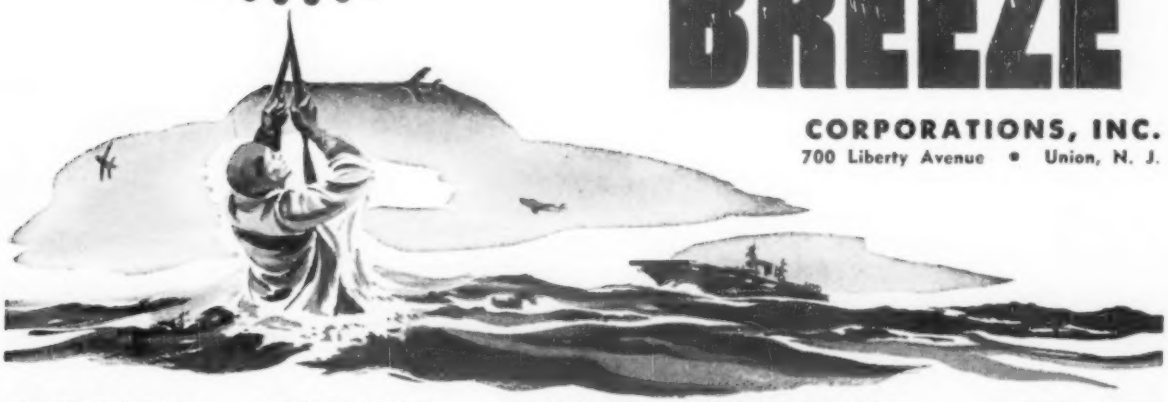

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the three prime contractors—Boeing, Douglas and Lockheed.

Chairman of the Production Committee is Lt. Col. R. J. Disher, who reports directly to AMC's Office of Director of Procurement and Production, headed by Maj. Gen. D. H. Baker, who in turn reports to Gen. E. W. Rawlings, Commander, AMC. Contractor representatives are Boeing's D. C. Bourland, Lockheed's P. D. Hollowell, and Douglas' L. C. Sebring.

▶ **Unanimous Vote**—The Production Committee started operations in 1951, when a broad base for the production of the B-47 was established and the three prime contractors were chosen to turn out the planes. To date there have been about 87 meetings of the committee. Some have lasted several days, some only a few hours.

Decisions of the committee are required to be unanimous. This is not always an easy attainment, but essentially unanimity resolves itself to a matter of give-and-take. The committee meets at the call of the chairman or upon request of any member.

There have been hardly any matters which were not ultimately resolved in the thousands of problems which have been discussed, although the representatives sometimes have started out with widely varying ideas.

In many of the specific problems, AMC may not have a direct interest because it will get a good product in any event. But where the chairman feels that Air Force interest may be jeopardized, he will exert pressure as a member of the committee.

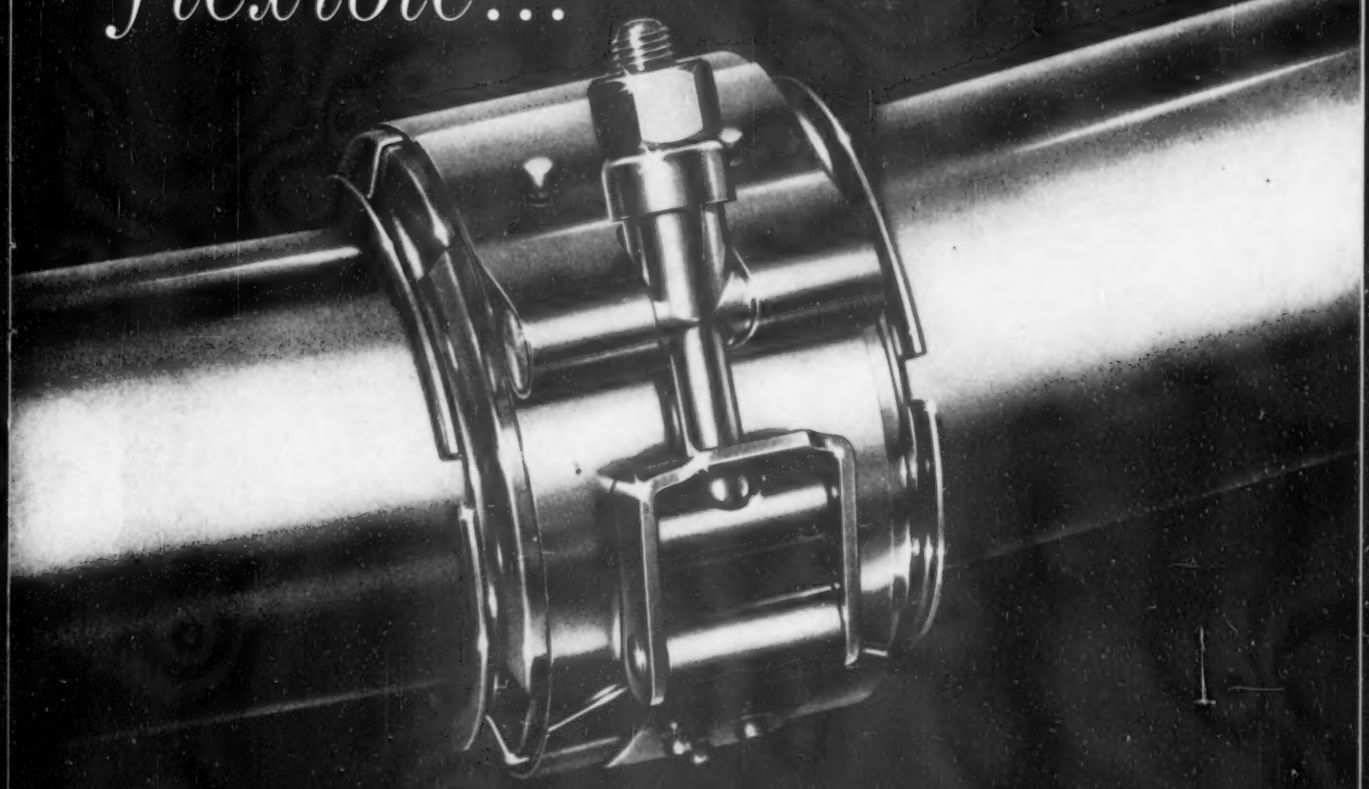
▶ **Choosing Subcontractors**—One of the big jobs which confronts the committee is concerned with recommendations for the establishment of controlled subcontract items.

The committee recommends who the subcontractor shall be and assigns the technical prime contractor (any one of the three companies) to monitor that subcontractor for the program. The subcontractor may supply one or more of the three companies with a component such as a wing.

▶ **The Vital Gages**—A big assignment for the Production Committee was the master gage program. Before the gages were in existence, the committee had to determine which contractor was going to get what gage on which date. This was a complex situation because none of the three primes builds the plane in the same order—production planning varies between the three companies.

The master gage program is one of the keys to interchangeability and standardization. With three different companies producing the plane, there is one set of master control gages. These gages are actually the heart of the program because they control the master

*flexible...**



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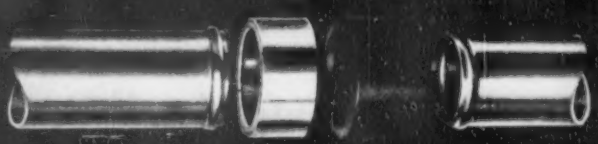

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**TYPICAL PERFORMANCE CHARACTERISTICS**

| | |
|---|---|
| **Vibration Resistance:** | 10-55 cycles at 1/16" double amplitude<br>55-500 cycles at 15 "G"<br>55-1,000 cycles at 15 "G"<br>55-2,000 cycles at 10 "G" |
| **Temperature Range:** | —55° to + 85°C.<br>—65° to + 125°C.<br>—65° to + 200°C. |
| **Coils:** | Resistances—1 ohm to 50,000 ohms<br>Arrangements—single coil;<br>two independent coils, either or both of which will operate unit |
| **Insulation Resistance:** | 1,000 megohms at room temperature<br>100 megohms at 200°C. |
| **Dielectric Strength:** | 450 to 1,250 V., RMS |
| **Operating Time:** | 24 V. models 10 ms. or less; dropout less than 3ms. |
| **Contacts:** | 30V., D.C.; 115V., A.C.; 2, 5, 7½ and 10A., resistive; 2 and 5A. inductive.<br>Minimum 100,000 cycles life.<br>Low interelectrode capacitance — less than 5 mmf. contacts to case; less than 2½ mmf. between contacts.<br>Special Ratings: to 350 V., D.C., 400 MA., or other combinations including very low voltages and amperages or amperages to 20. |
| **Operational Shock Resistance:** | 30, 40 and 50 "G" plus |
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| **Mounting:** | 9 standard arrangements to meet all needs — plus ceramic plug-in socket. |
| **Size:** | 1.6 cu. in. |
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gages for the three primes and the subcontractors in the manufacture of parts.

From these master gages, the production tooling was evolved.

►**Check on Interchangeability**—The Production Committee is charged with control over spares configuration to insure that regardless of which of the three primes or subcontractor builds the part, it will fit any B-47 made by any one of the three companies. This, in effect, is standardization insurance.

Some of these spares are classed as interchangeable, while others are classed as replaceable, meaning that they may require a little work to make them fit.

All interchangeability checks (on actual samples) are accomplished at the Boeing-Wichita facilities. Parts and assemblies from the Douglas and Lockheed plants are shipped to Boeing and the interchangeability checks are scheduled in through the production line.

All engineering changes affecting interchangeability are submitted to the committee for coordination of effective points. All master gages affected by these changes are returned to Boeing-Wichita for rework. The schedules for the recall, rework and return are all coordinated through the committee. These schedules are developed so that the master gage requirements of all three companies are satisfied.

Another activity of the B-47 Production Committee is the maintenance of an up-to-date group book, a specification defining what the subcontractor should produce. This group book is, in effect, the subcontractor's bible and represents a coalition of the different and sometimes widely varying ideas from the three companies.

The committee also determines the engineering data and assistance, tools and tooling data, manufacturing data and any other technical assistance to be furnished by Boeing to each other contractor. It controls the release and distribution of drawings and all technical information between companies.

The committee also may recommend to the Air Force and the participating contractors manufacturing and quality control methods and procedures.

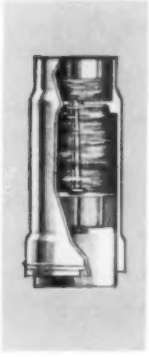
►**Delegated Responsibility**—The Production Committee has formed subcommittees operating in specific areas such as tooling, quality control, and engineering change control.

Reporting to the Production Committee, the subcommittees are patterned after the parent activity. Thus, there is an AMC chairman and a representative from each prime contractor.

The subcommittee members are experts in their particular fields and do the detail work as technical specialists for the Production Committee members, making representations to the latter for decision. ■ ■ ■

# Little bounces that mustn't grow up...

## ARE RESTRAINED BY AIR AND OIL



If you ever rocked a car to get it out of a mud hole, you know how effective those rhythmic little pushes were in building up the big push that eventually moved the car right out of the hole.

The helicopter manufacturers were running into the same rhythmic pushes... but *these* were causing trouble.

On the ground, the weight of the three rotating 'copter blades shifts unevenly from side to side. The slow side-to-side oscillation was building up waves of energy in the tires and landing-gear shock absorbers. Eventually, the waves grew big enough to tip over the helicopter in a mass of splintered rotor blades.

Our engineers developed a damper or *counter*-shock-absorber to squelch the little bounces *before* they build up into 'copter-wrecking forces. This damper is a part of the AEROL Landing Gear we designed and build.

Vibrations which start out small but build up into serious waves are a headache that many different industries are turning over to Cleveland Pneumatic engineers for a solution.

*Write for illustrated booklet C-8.*

**Cleveland Pneumatic**
*Tool Company* CLEVELAND 3, OHIO

Department C-8

BALL-SCREW ACTUATORS • AIR-OIL IMPACT ABSORBERS

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Combining the screw with balls makes Cleveland Pneumatic's patented ball-screw actuator drive with as little as 10% friction . . . compared to as much as 50% for ordinary screw drives. You can cut the weight of a drive system, reduce its space, lessen its cumbersomeness, increase its control accuracy, and provide pin-point positioning. Let our engineers work out your ideas for our ball-screw actuators.

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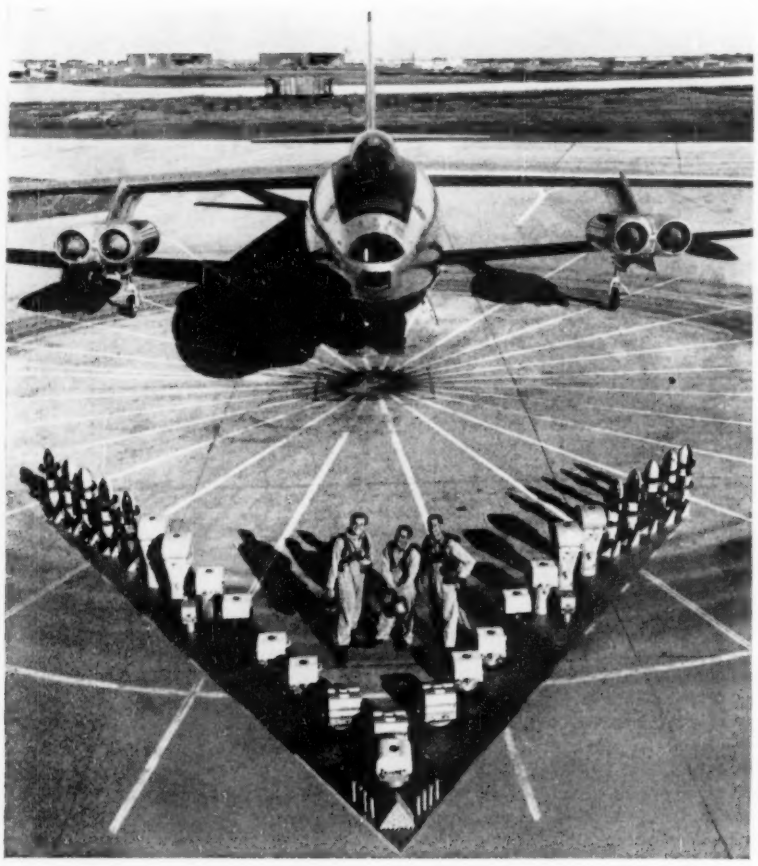
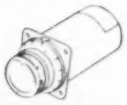
## AT SUPERSONIC SPEEDS
## *with* ***ABRAMS Intervalometers***



Aerial photographic equipment coordinated for use with the Boeing RB-47E. With the plane and crew are shown, seven types of cameras, cartridge flares in foreground, with flash bombs at extremities of the "V". Abrams Instrument Corporation intervalometers, counters and count limiters are used for time control and recording.

DESIGNERS AND MANUFACTURERS

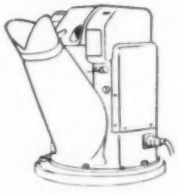


INTERVALOMETERS

COUNT LIMITERS

COUNTERS

B-8A INTERVALOMETER



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# How AF Runs $10.6-Billion Spares Setup

By Katherine Johnsen

**Air Force's area of continual improvement that never will reach perfection is the $10.6-billion spares and spare parts program. Objective of the program can be simply stated: to order the "right" parts, in the "right" amounts, and have them in the "right" place at the "right" times.**

For perspective on the complexity of the program, consider this:

USAF procures more than 500,000 different spares and spare parts to support its aircraft. More than 470 factors enter into the estimation of future requirements for spares.

► **Wide Variations**—Some parts are bought by the millions (such as standard hardware), complicating inventory control. Other parts are bought by ones, twos, and threes (such as spare wings), complicating development of stocks. They must be at the right places at the right times, and there are not many to spread over USAF's worldwide organization.

The program ranges from tiny lockwashers costing a fraction of a cent to high-powered engines costing a quarter of a million dollars.

Each fluctuation in the USAF program leaves a backwash of problems for the management of the spares and spare parts program, headed by Brig. Gen. Frederick Dau, director of supply and services, Air Materiel Command. Each revision in aircraft design means a change in parts procurement, perhaps the procurement of hundreds of parts. Each change in the operational program—the decision of a commander to fly one type plane more and another type less—raises problems demanding redistribution to avoid over-stocking and under-stocking.

## Computing Requirements

► **Factors**—Dau describes the computation of spares and spare parts requirements:

"It involves a multitude of people at each of our depots and at higher echelons. It involves reams of programming information, past and future, masses of asset and user data, many worksheets, extensive machine calculations. In essence, we collect the experience data on each of the 500,000-odd items, derive consumption factors, project this against the future program, subtract all assets—stocks on hand and on order, and arrive at a net requirement. Even with a detailed 500,000-item computation, the question of whether the huge result is too much or too little on a judgment basis remains.

"Percentages are not good measures since both war and peace deployments and rates of activity affect and may alter them."

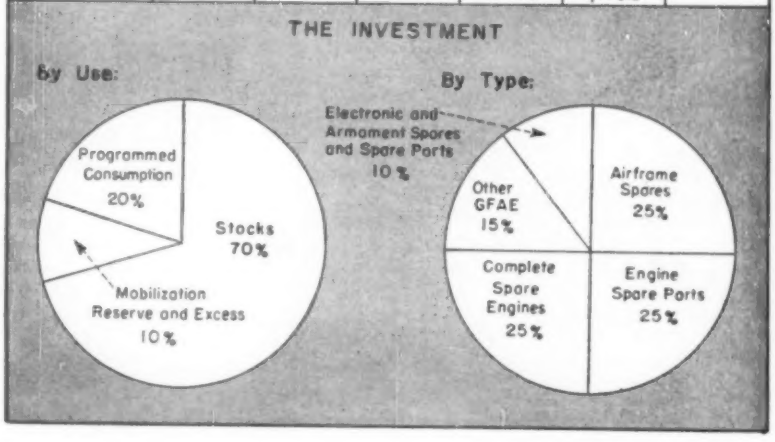
After the initial mobilization haste of the Korean war, early in 1952 USAF turned to the spares and spare parts program as its obvious fertile area for improvement—for money saving through more exacting procurement and deployment. The two main approaches are high-value control and dollar inventory control.

► **High-Value Control**—The special "spares study group," headed by industrialist H. O. King, grasped the im-

### USAF'S INVESTMENT IN SPARES AND SPARE PARTS: $10.6 BILLION

This is the fiscal picture on USAF's spares and spare parts program, showing an on hand inventory of over $4.6 billion and a backlog either on order or to be ordered of over $6 billion

| | Initial Spares:—to support aircraft during first 12 months service | Initial Spares:—to provide for major modification or conversion of aircraft | Maintenance Spares:—to support aircraft after 12 months service | Maintenance Spares:—to provide for corrective modifications | | |
|---|---|---|---|---|---|---|
| Inventory: July 1, 1950 | | | | | | 2,820.6 |
| Gains: Appropriations | 7,942.4 | 231.0 | 2,272.7 | 375.6 | | 10,821.7 |
| Fiscal 1951 | 3,060.0 | 28.7 | 576.6 | | 3,665.3 | |
| 1952 | 2,470.6 | 19.5 | 697.5 | | 3,187.6 | |
| 1953 | 1,563.9 | 21.6 | 347.9 | 129.8 | 2,063.2 | |
| 1954 | 672.0 | 19.0 | 250.7 | 120.8 | 1,062.5 | |
| 1955 | 175.9 | 142.2 | 400.0 | 125.0 | 843.1 | |
| Losses: | | | | | | 2,976.2 |
| Consumption | | | | | 1,900.2 | |
| Disposal | | | | | 267.0 | |
| Sales (primarily to military assistance program) | | | | | 113.2 | |
| Overhead(transportation,packaging costs,etc) | | | | | 695.8 | |
| Current Assets: | | | | | | 10,666.1 |
| On hand | | | | | 4,646.8 | |
| On order | 4,296.2 | 45.7 | 228.0 | 250.6 | 4,308.4 | |
| To be ordered | 1,037.0 | 148.9 | 400.0 | 125.0 | 1,710.9 | |



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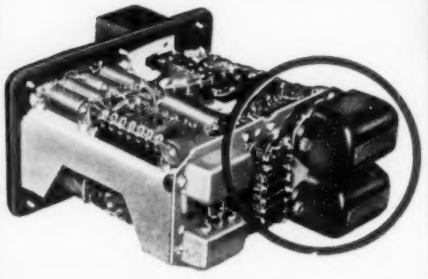

The complete line of Barber-Colman aircraft controls includes: Valves; Positioning Controls; Actuators; Temperature Controls; Small Motors; Ultra-Sensitive Relays; Thermo-Sensitive Elements. Write for catalog F-4141. Engineering sales offices in Los Angeles, Seattle, Baltimore, New York, Montreal.

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## HIGH-VALUE CONTROL

**Two and nine-tenths percent of the number of aircraft spares account for 61.8% of the dollar investment. These are the items USAF is closely monitoring in its efforts to economize.**

| Aircraft | Total Number of Spares | Number of High-Value Spares | Percent of High-Value Items | Total Investment in Spares (in millions of dollars) | Investment in High-Value Items (in millions of dollars) | Percent of Controlled Investment |
|---|---|---|---|---|---|---|
| B-47 | 6,800 | 163 | 2.3 % | $272.2 | $149.7 | 55 % |
| B-52 | 8,000 | 353 | 4.4 | 120.7 | 101.4 | 84 |
| B-57 | 3,822 | 106 | 2.7 | 24.5 | 23.4 | 96.5 |
| RB/B-66 | 3,663 | 123 | 3.4 | 15.3 | 5.8 | 37.9 |
| C-97 | 5,522 | 114 | 2.1 | 99.8 | 50.4 | 50.5 |
| C-118 | 5,400 | 122 | 2.3 | 16.3 | 5.6 | 34.4 |
| C-119 | 3,000 | 141 | 4.7 | 50.2 | 25.2 | 50.2 |
| C-124 | 8,000 | 300 | 3.7 | 80.0 | 47.3 | 59.1 |
| F-84 | 2,676 | 57 | 2.1 | 129.4 | 96.9 | 74.9 |
| F-86 | 3,800 | 109 | 2.8 | 237.3 | 149.5 | 63.0 |
| F-89 | 5,050 | 91 | 1.8 | 94.9 | 54.3 | 57.2 |
| F-100 | 4,250 | 92 | 2.2 | 12.0 | 4.6 | 38.3 |
| F-101 | 3,038 | 141 | 4.6 | 4.6 | 3.5 | 76.0 |
| F-102 | 2,600 | 75 | 2.9 | 7.5 | 4.3 | 57.3 |
| T-29 | 5,000 | 100 | 2.0 | 18.6 | 8.0 | 43.0 |
| T-33 | 2,400 | 92 | 3.8 | 46.6 | 29.8 | 63.9 |
| TOTAL | 73,021 | 2,182 | 2.9 % | $1,229.6 | $759.7 | 61.8 % |

possibility of exacting procurement and exacting control over all of the 500,000 items in the program. Until then, comparable controls had been used on all items in the inventory.

The group's first study developed that a small "number" of items comprise the major part of the total dollar investment. It showed that 2.9% of the number of different spares and spare parts for airframes accounted for 61.8% of the total investment. By focusing attention on this small number of parts, the bulk of the money could be better controlled. Measures to minimize procurement, expedite distribution, reduce repair cycles and other "in pipeline" elements, and tighten up inventory control on these high-value items were initiated.

▶ **$90-Million Reduction**—Re-computations, resulting from the initial implementation of this high-value control program for airframe spares and spare parts, USAF reports, resulted in a net reduction of $90 million. Implementation is a continuing process. Experience factors and the expeditious reporting of them and reflection of them in the program continue to perfect control.

USAF emphasizes that the biggest saving through its high-value program for spares is not in the vast reduction of dollars, but in the amount of spares and spare parts that were not or will not be programmed because of improved controls.

Rigid controls also have been applied to the highest-cost single item in the program, spare engines. Re-computations, by actuarial methods, of the time-between-overhaul factor, alone, USAF reports, have reduced requirements by hundreds of millions of dollars.

USAF now is drawing up selective lists of the high-value spares and spare parts involved in the engine program, the electronics, guided missile, and armament programs. The results are not expected to be as rewarding as in the airframe spares study since reductions have already been accomplished to a great degree. Spare parts in some of these areas tend to approximate each other in cost and in the total investment involved. In the airframe area the demarcation between the new high-cost items and the low-cost items is sharper.

▶ **Dollar Inventory Control**—USAF's institution of "dollar" inventory control, a project that started a year ago and is scheduled to be completely in effect by July 1955, will have its major impact in the spares and spare parts program.

Previously the program was under "item" control. One million bearings, costing three-tenths of one cent each would show up on parts inventory as "1,000,000." Ten B-52 fin tip assemblies, costing $50,760 each, would show up as "10."

Under the dollar inventory system, the bearings stock will show up as $3,000; the tip assembly stock will


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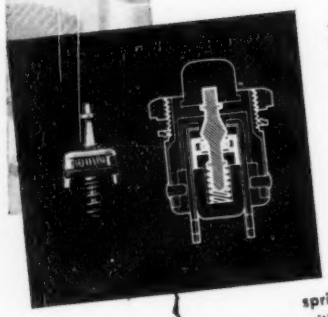

. . . an exceptionally positive snap-action that makes it impossible to "tease" the switch ON or OFF contact.

. . . lightning-fast contact make or break for reduced arcing. (Hetherington switches are smaller, carry higher ratings because of this unusually fast action.)

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. . . highest quality construction —polished taper, beryllium copper springs, contacts and terminals of copper with heavy silver overlay—all designed for a minimum life of 50,000 cycles under rated load.

Today more and more appliance and equipment manufacturers recognize that using dependable, space-saving Hetherington switches is really far-sighted economy. Send details of your application for a prompt recommendation by Hetherington switch specialists.

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show up as $507,600. Fiscal management will be able to concentrate on the areas of big money investment in efforts to control inventory.

► **Difference Apparent**—A slight overstocking of less-than-a-cent items, money-wise, means little. But a slight over-stocking of $20,000 items might add up to millions of dollars. Areas of maldistribution (overstocked at one base and under at another) that do not show up on the item inventory will be discernable under the dollar inventory.

When the Air Force knows the items in which its money is invested, it will be in a realistic position to control inventory.

Since the outbreak of the Korean war in mid-1950, $10 billion has been appropriated for the spares and spare parts program. This compares with $18.6 billion for complete aircraft plus additional funds for modification. Annually, out of every dollar for the two procurement programs, 70 cents has been for complete aircraft and about 30 cents, including items procured initially, those to support flying programs, and those to support modifications for spares and spare parts to support the aircraft.

It should be noted that a large part of the $10 billion for spares is required to support older aircraft already in service prior to the $18.6 billion appropriated for new aircraft.

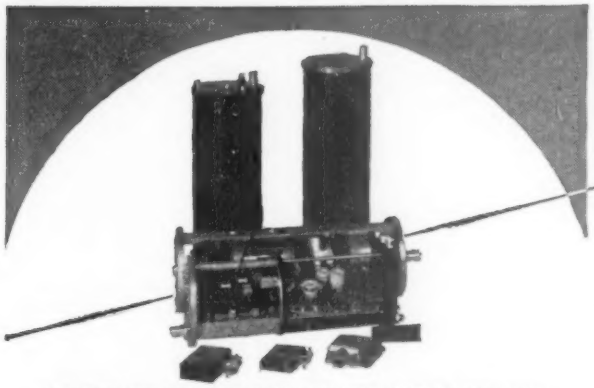
Key men in the spares and spare parts program are:

**Brig. Gen. Frederick Dau** is director of supply and services. An engineering and intelligence officer since graduation from the Military Academy in 1928, Dau coordinated the mapping efforts for the two invasions of World War II—from the English Channel and the Mediterranian. From data on aircraft to be procured from the Deputy Chie of Staff for Materiel and from data on USAF's operational program, personnel in AMC headquarters and in the nationwide depot system under Dau's direction compute the spares and spare parts requirement and program the deployment to depots and bases.

**H. O. King,** is chairman of the "spares study group" established in 1952 to tackle the problem of bringing more of the exact science element into the program. King's answer was high-value control. During World War II he headed War Production Board's copper division and later was chairman of the combined allied copper committee. King is board chairman of Munson Line, and a director of numerous firms, including Huylers, Inc., Texas Gulf Producing Co., and Southern Arizona Bank and Trust Co.

## Spares Program

USAF's spares and spare parts pro-



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Uses a 30 RPS commutator to sample 28 data sources in the 0 to +5 volt range. 4 to 5 watt crystal-controlled RF transmitter is frequency modulated. Equipment is sealed and pressurized for high altitude operation, and withstands ambient temperatures from −40°F to +140°F, 100g shock, and 12g vibration. Transmitting equipment is also available with other sampling rates and numbers of channels and in different packages for separate applications. Bulletin FBA-1.

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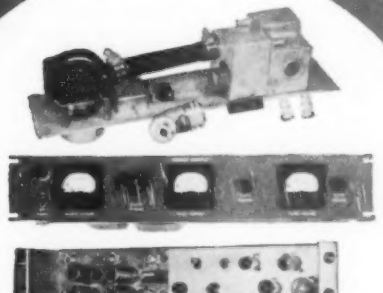

**MODELS APA-1 RF PREAMPLIFIER AND AMC-1 MULTICOUPLER**

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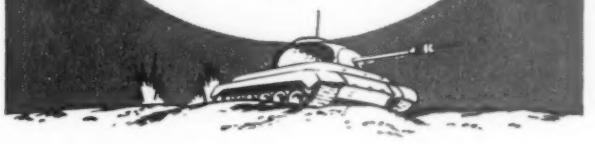

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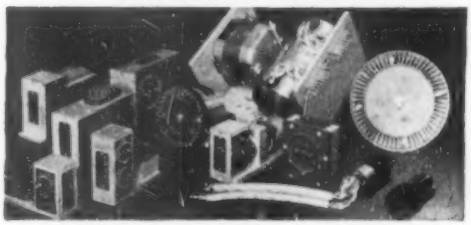

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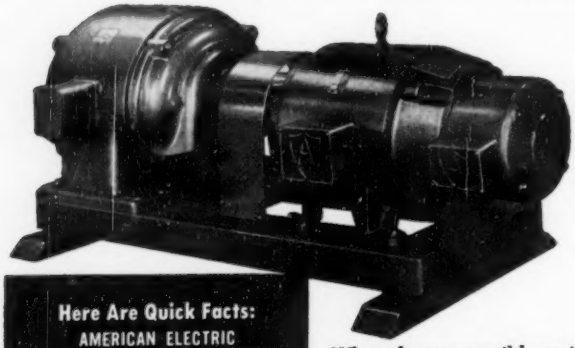

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**CAPACITY RANGE**—15 KVA to 40 KVA (in stock). Up to 75 KVA on special order.

**FAST RECOVERY**—Better than .2 seconds.

**LOW VOLTAGE OVERSHOOT**—Less than 10%.

**TOTAL HARMONIC CONTENT**—Under 5% on unbalanced 3-phase loads.

These characteristics apply to general uses. Where applications are specific, even better characteristics can be developed.

Where lowest possible maintenance, combined with excellent wave form characteristics are required, it's hard to match American Electric's Inductor-Type Alternators. But occasionally *special requirements arise* which may be better served by American Electric's Revolving Field Alternators.

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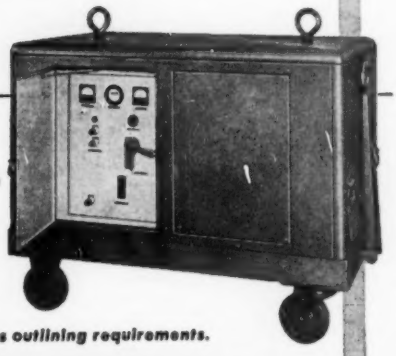
Employs American Electric's trouble-free, direct-connected, high-cycle Inductor Alternator—which has no commutator, slip rings, brushes, springs, etc. Output is rectified and exciter-regulated by either electronic or magnetic amplifier means, then returned to the rotating field of the main alternator.



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gram is divided into four sub-programs. These are: initial modification, follow-on and corrective spares.

▶ **Initial Spares**—This major sub-program provides spares and spare parts for aircraft for the first twelve months' service, plus a stock level of five and a half months. Deliveries are made with complete aircraft.

The estimating of requirements for older-type aircraft is based on data obtained from operational experience. On new types, the estimating which would be supported by "initial spares," can only be related to operational experience data on similar type aircraft. The objective of the high-value project is to perfect the estimating in the areas of big investment.

More than 25% of the $7.9 billion that has been appropriated for this sub-program since the Korean outbreak has been for spare engines.

New money for initial spares and parts has dropped sharply—from more than $3 billion in fiscal 1951, the first year of the Korean war, to $176 million for the current fiscal 1955 year.

▶ **Funds Decrease**—Aside from the anticipated decline of procurement commitments as the 137-wing force progresses, other factors figure in the drop in new funds from $682 million in fiscal 1954 to $176 million this year. USAF completed fiscal 1954 with an unobligated balance of $861 million. This carryover, plus the $176 million in new money, contemplates obligations this year at the high level of $1,037 million at a rate tailored to the ordering of new aircraft. While the Joint Chiefs of Staff re-evaluated the "interim" 120-wing program in effect last year, USAF was cautious about obligating funds. General Accounting Office established more stringent criteria as to what constitutes an obligation.

Here are a few of the questions, all involving complex data, that USAF raises in determining what and how many initial spares and spare parts to purchase with aircraft:

Is it a logical spare part? Can it be installed below depot level? Should it be stocked below depot level? The deployment of spares, determining their time "in pipeline," directly affects the procurement requirement. USAF is concentrating on maximizing repairs and installations of high-value spares at bases to cut the pipeline requirement involved in routing to depots. Is it subject to technical order compliance? What is its usage related to: flying hours, landings, accidents? Can it be repaired? At what level of maintenance can it be installed or repaired? How often will it have to be issued? At what rate will it wear out? What quantity will be needed for the pipeline? How long will it take to repair? What repair

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parts will be needed? Should it be included in a flyaway kit? Should it be included in reserve stocks, and in what quantity?

▶ **Modification Spares**—Spares and spare parts under this sub-program are necessitated by major changes in aircraft, usually made at the contractor's factory, such as changes due to assignment to a new mission, changes in configuration, revisions of military characteristics.

Changes in aircraft design, in production or subsequently, create one of the headaches of the management of the spares and spare parts program: What spares and parts do the design make obsolete?

One of the primary areas USAF is concentrating on in perfecting parts procurement and utilization is "interchangeability." Can a spare or part made obsolete, because of a design change or for other reasons, on one aircraft be utilized on another aircraft? To answer this question requires detailed and comprehensive inventory and characteristic data.

USAF expects to obligate about $180 million under this sub-program in fiscal 1955. Of this amount, $37 million is in carryover funds and $142 million in new money.

▶ **Follow-on Spares**—This sub-program is geared to the flying-hour program. Other factors, though, enter into the computation of requirements: consumption of the initial twelve months' supply, repair cycle and other pipeline factors, and matters of judgment, such as reserve requirements. For example, fluctuations in the repair cycle factor, the determination of time stocks are out of service, measurably reflect in the requirement. The increasing worldwide deployment of USAF squadrons is increasing the repair cycle and other pipeline problems.

On certain premium items, high-cost or urgently needed items, USAF uses air transportation to cut down the out-of-service time. But USAF is reluctant to become reliant on airlift, which would be required for troop transport and other high-priority missions in an emergency.

Dau comments:

"Air transportation would certainly reduce in-transit time wherever applied and, with assured rapid delivery, would warrant reduction of stocks on hand in many instances. This in turn would mean reduced warehousing. However, no real change can be accomplished without assured aerial delivery, both in peace and in war."

▶ **Expand Local Purchases**—In an attempt to cut down the warehousing bill for its mounting spares and spare parts inventory, USAF is expanding the local-purchase concept and promoting closer contractor-user relationship.

The main reason the follow-on spares

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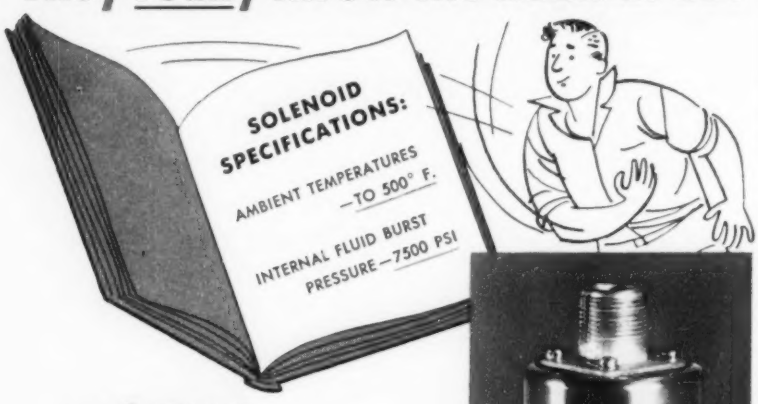


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and spare parts sub-program costs substantially less than the initial spares program is that it does not include spare engine procurement and many other items not normally consumed in operations. Since the Korean outbreak, $2.3 billion has been appropriated for the follow-on program, compared with $7.9 billion for the initial spares program, of which $2.8 billion is for complete engines.

This year, the follow-on program is being increased from $250 million in fiscal 1954 to $400 million. This is because operational flying was less last year under the 120-wing program, a greater portion of the aircraft to be supported are of modern, more-expensive models and the need for raising Air Force levels of strategic reserves.

Procurement of maintenance spares for individual aircraft illustrates the cycle in the follow-on program:

• **B-57.** Maintenance parts will multiply from $596,000 in fiscal 1954 to $4.5 million in fiscal 1955. Large-scale production of the plane started a year ago, and fiscal 1954 operations primarily were supported with initial spares. The consumable portions of this first year's support stock will be exhausted for an increasing number of B-57s over the coming year.

• **B-36.** Maintenance parts will jump from $7.5 million in fiscal 1954 to $21 million in fiscal 1955. Initial spares procurement supported 25% of the B-36 fleet in fiscal 1954. But production has tapered off and the percentage of the fleet that will be supported from the initial spares program in fiscal 1955 is down to 7%.

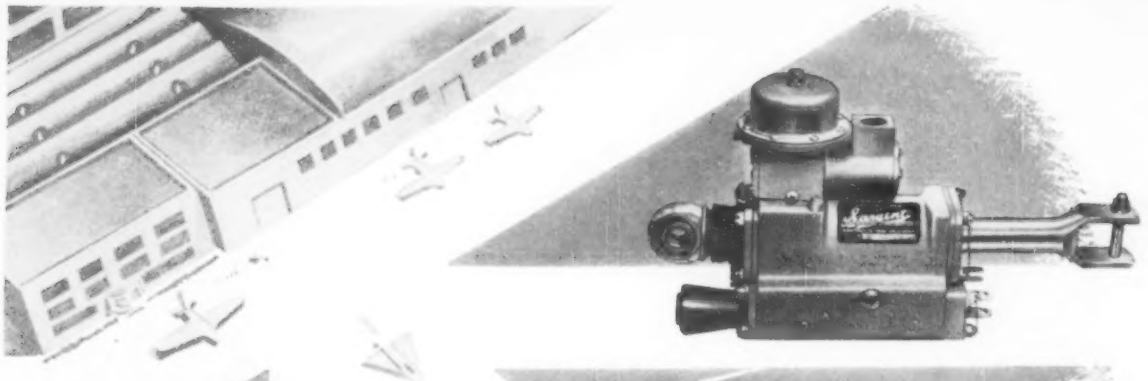
• **B-29.** Maintenance parts will drop from $47 million in fiscal 1954 to $1 million in fiscal 1955. The plane is being phased out.

► **Corrective Spares**—This sub-program supports the initial spares and spare parts required because of "corrective" modification of in-service planes. It is usually a comparatively minor modification made at the base level to improve safety characteristics or to correct failures or deficiencies in the installed equipment. The need for corrective maintenance declines with the life of the aircraft.

Funds for this corrective maintenance program have remained fairly stable: $130 million in fiscal 1953; $121 million in fiscal 1954; and $125 million for fiscal 1955. Of course, only a minor portion of these dollars are expended for additional spares to support this corrective maintenance.

## Inventory & Consumption

A striking feature of the spares and parts program is the comparison of



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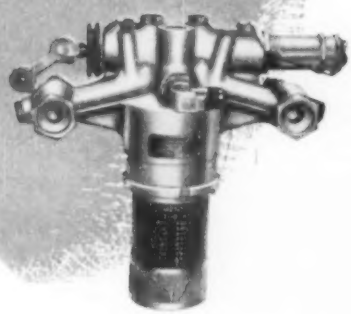

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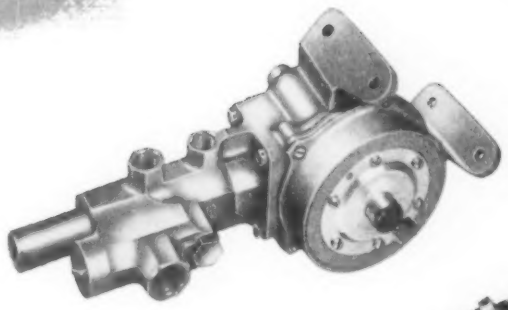

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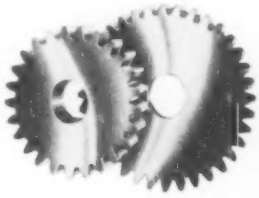

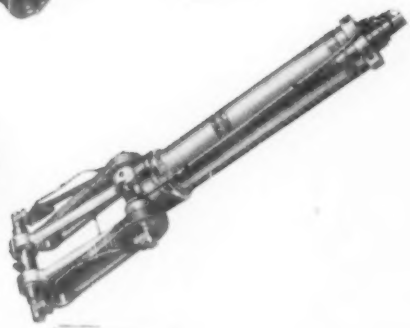

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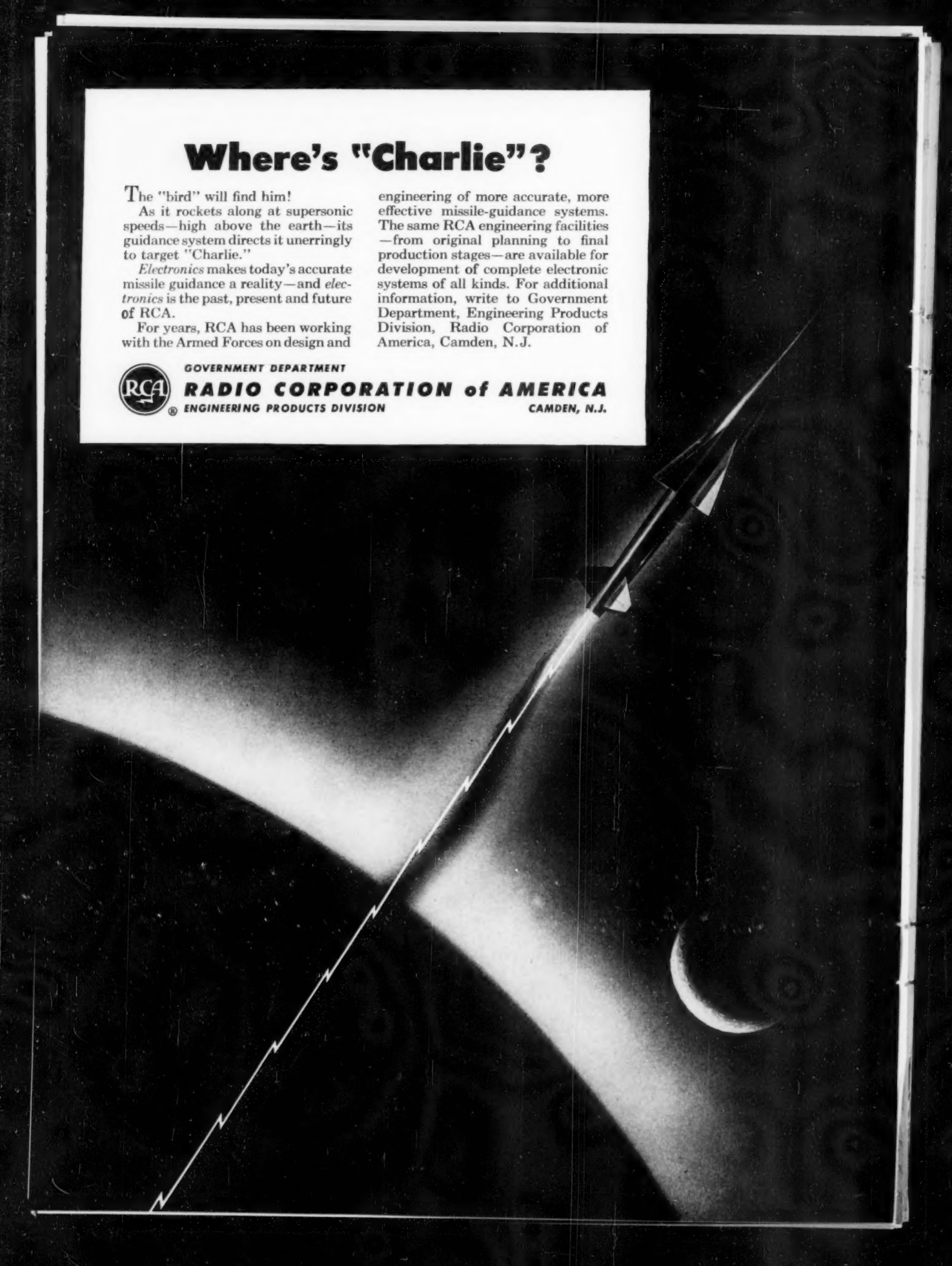


inventory with consumption:

USAF now has on hand or on order almost $9 billion in items, and plans to order over $1.7 billion more this year. Consumption since the Korean outbreak, over four years ago, has been less than $2 billion.

This raises one of the most-asked congressional questions: Why not work down the inventory—use it up or dispose of it?

Consumption — showing worn-out items that must be replaced—is only one of five considerations in explaining requirements. Of USAF's $10.6-billion investment in spares and spare parts, slightly less than 20% is estimated for consumption.

The four other considerations are:

• **Readiness reserve.** This is the backlog required to support the regular Air Force and reserve components that would be put immediately into action, from the outbreak of a war to a planned time thereafter when expanded production could meet combat needs.

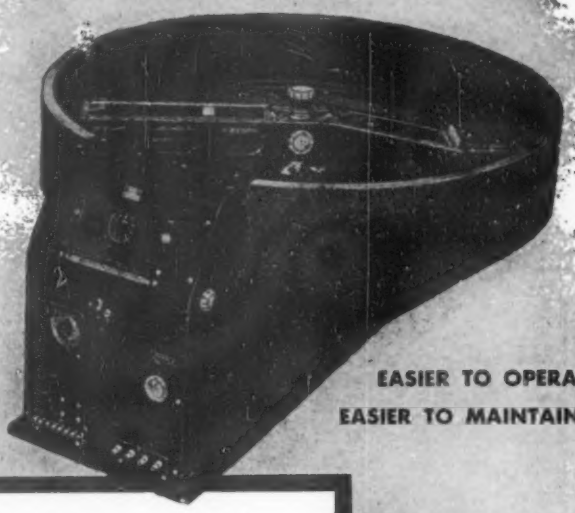
AF favors a reserve sufficient to the needs of a major conflict until that time. In only limited war-consumable items, however, has this level been achieved. The readiness reserve accounts for approximately 10% of the investment in spares and spare parts.

• **Stock supply.** This is the five-and-a-half-month stock level required to assure against the grounding of planes for lack of spares or spare parts. It provides for replacement of items drawn out of service, in pipeline either for repairs, new deployment, or other reasons and is divided among depots in the U.S. and overseas and the operating bases. The pipeline requirements—the stock required to insure our uninterrupted flow of serviceable items to the user to replace damaged or worn items enroute to and being worked on in the maintenance shops—is set at four-and-a-half months for the continental U.S. and at seven months for overseas. Stock represents approximately 20% of the investment in spares and spare parts.

• **Engines.** Because of their high cost, spare engines are managed separately. This program represents approximately 30% or $3 billion of the total investment in spares and spare parts that is never "consumed." It shows up as inventory, until disposed of. Spare engines are computed on the basis of four and one-half months pipeline in the U.S. and seven months overseas to support the overhand cycle. Some spare engines are included in the readiness reserve and the stock supply.

• **Contingency spares.** These are new-plane spares for which there is no usage information to make a procurement decision for use, stock, or reserve. It becomes a management judgment as to what might be required for some contingency. This represents approximately


GENISCO'S MODEL B
G-ACCELERATOR



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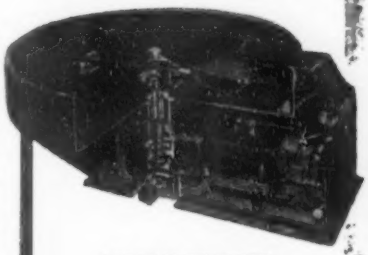

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10% of the Air Force's investment.

• **Mobilization excess.** Spares and spare parts in this category are for planes that are being phased out of service. These items previously were procured in order to fill a need in one of the other categories.

The question is whether they should be "retained" to meet a possible mobilization effort or be declared excess and disposed of. Air Force is conservative in disposing of stocks.

Dau explains:

"We must weigh the possibility of future unpredictable but vital needs against the cost of maintenance and upkeep. . . . Recognizing the ever-changing requirements . . . through the dictates of world affairs . . . we did not dispose of our support spares for the B-26 after World War II. These aircraft were used extensively in Korea and in Indo-China. Similarly we retained large quantities of parts for the P-51, also used in Korea."

USAF now is disposing of more than $1.1 billion described as the "mobilization excess" program. So far, disposals have been small compared with acquisitions to support the expanding Air Force. The total disposal program since the Korean outbreak totals $267 million (original cost) in engines and a comparable amount of other aircraft.


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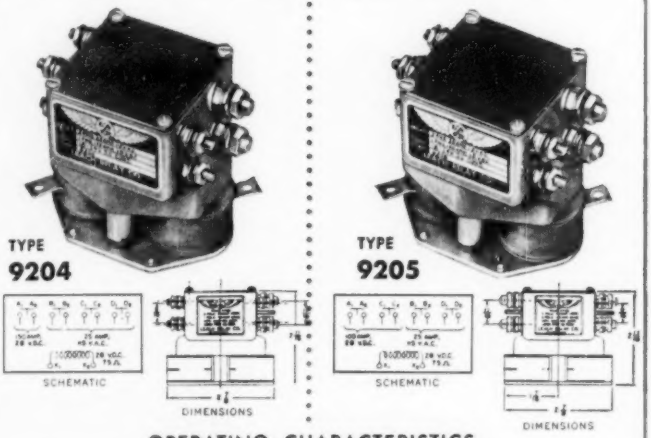


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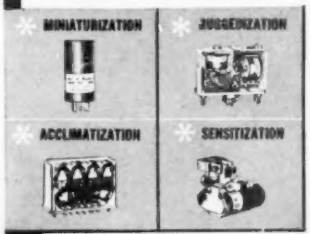


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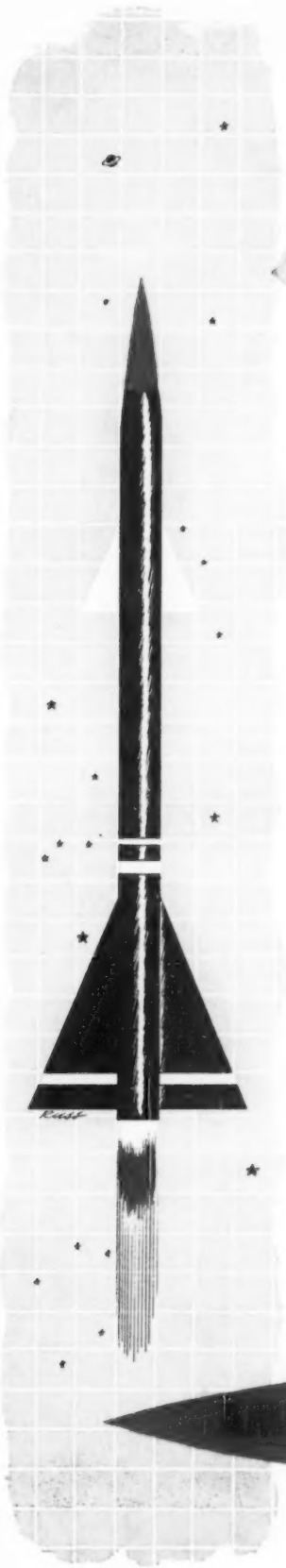

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• No military spares or spare parts, as such, will be put on the market. This is dictated by the State Department because they might fall into the hands of speculators for re-sale to other nations. These parts will be de-militarized, reduced to their basic material content.

• Army and Navy will have first claim on stocks USAF decides are surplus. Next, other government agencies will have priority, and then state schools and welfare programs. Other government agencies are not expected, however, to find use for USAF's surpluses in spares and spare parts.

• Sales will be by competitive bidding (auction, sealed bids or stock bids) at depots. USAF plans steps to insure against "dumping" that might interfere with a manufacturer's market. Interested manufacturers, for example, will be notified of prospective sales. They will have opportunity to outbid others. USAF expects most of the surplus to go to junk dealers, who have been ingenious in devising odd uses for spares and spare parts, such as making boats out of wing tanks. ■ ■ ■


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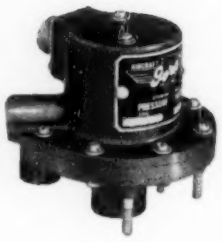

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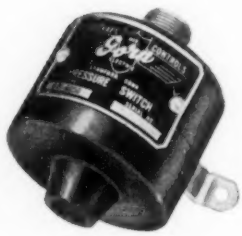

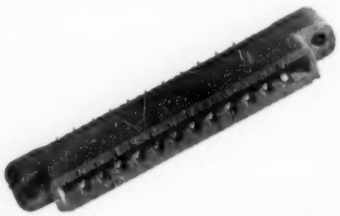

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*What they are*

*Heli-Coil** screw thread inserts are precision-formed coils of stainless steel or phosphor bronze wire. Wound into tapped holes, they form permanent non-corrosive, strip-proof threads of astonishing strength.

*How they cut weight*

Threads tapped in aluminum or magnesium when protected by *Heli-Coil* inserts are much stronger, therefore you can use smaller, fewer, shorter cap screws for required strength. Fewer or shorter cap screws mean savings in fastening-weight, through lighter bosses, thinner flanges, and thinner wall sections.

*What they are for*

AS ORIGINAL COMPONENTS: *Heli-Coil* inserts are used to provide stronger, lighter fastenings, corrosion-proof, wear-proof, threads in all assemblies. Thus you find *Heli-Coil* inserts throughout aircraft engines, airframes, and accessories, from the heart of jet engines to skin inspection panels.

FOR PRODUCTION SALVAGE: When conventional tapped holes are damaged in production, restore them on the line with *Heli-Coil* inserts. Get better-than-original strength with no increase in screw size and no telltale signs of rework.

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*How they work*

Holes are drilled and tapped as you do for ordinary threads—then *Heli-Coil* inserts are wound into tapped holes by hand or power tools. Install in a few seconds, assure thread protection forever. Can be used in any metal, wood or plastic.

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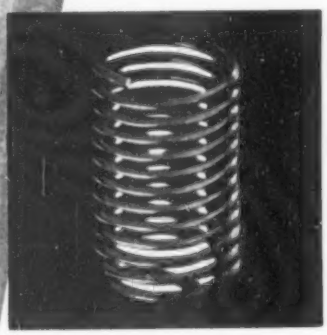

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# Surgeon's Job: Fight AF Health Hazards

**This station would appreciate recommendations for protecting workers on overhaul of radioactive aircraft. . . . Request that the subject oxygen-system tubing recovered from crashed aircraft be analyzed for possible contamination. . . . Nearby farmer claims cows died from drinking from polluted stream below this installation. . . . Clerical help complained of headaches and nausea while making reproduction copies of documents; fluid used in process contains methanol. . . .**

Page after page, reports like this filter through the Surgeon's office at Air Materiel Command headquarters. They tell the accident and health story of the AMAs and depots under AMC. They report and ask questions. They pose problems that must be solved.

They typify the many tasks of industrial medicine in the United States Air Force.

▶ **Medical Job**—There is only one single purpose for the existence of the medical service in the USAF: to increase and then maintain the productive efficiency of each employe, from pilot to painter, from crewman to cashier, from mechanic to musician.

That statement covers a multitude of tasks; it explains the usual jobs of medical men everywhere—caring for injuries and sicknesses, performing operations, extracting teeth, giving shots. But the words "productive efficiency" give a new twist to an old job, and define additional areas of responsibility.

Out of this added responsibility has grown the team concept, as practiced in the USAF medical service. The team links the specialized talents of engineers, physicians, health educators and other specialized personnel into a unit. Each member is a specialist; each understands some of the other's problems and has some knowledge of the other's profession. But the complexity of today's industry has made the team an indispensable item.

▶ **Teamwork**—Spray-painting provides a simple illustration of how the team concept works out in practice. By breathing the contaminated air, an unprotected worker can absorb toxic materials from painting with spray equipment and become sick.

The doctor prescribes a mask or a respirator to prevent the illness from recurring; the engineer designs a spray booth with adequate ventilation. Between them, the doctor and the engineer have protected the worker against an occupational health hazard.

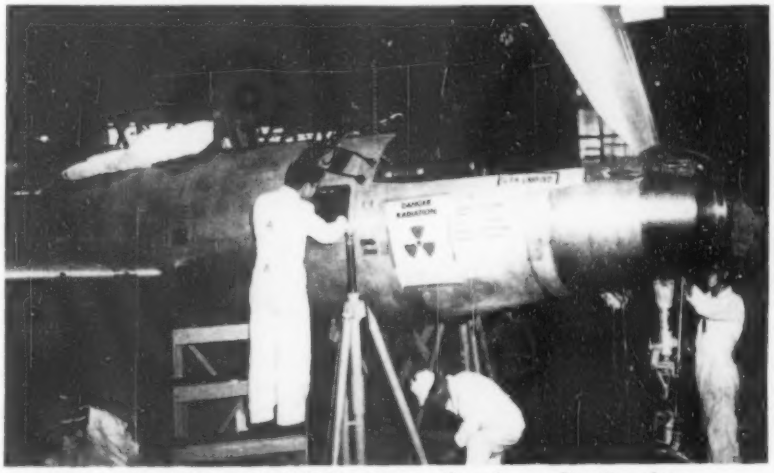
This example also illustrates the situation which creates a hazard. There must be a source of exposure to some chemical, physical or biological substance (the atomized paint); there must be an unprotected worker, and there must be some medium of transmission (the contaminated air) .

It is the job of the preventive-medicine team to recognize situations like this, if possible before they have a chance to exist. That is why one of the important functions of the team is to give advise on new construction, new designs, and even new production techniques.

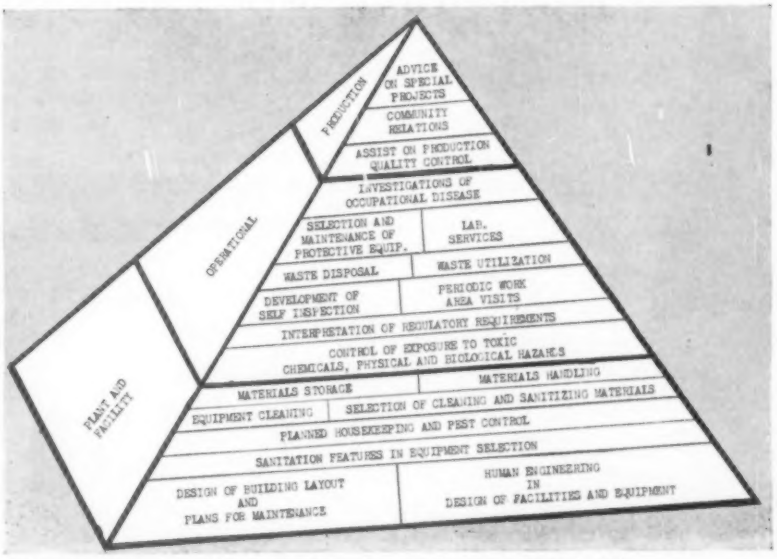
▶ **Case History**—A major aircraft company, getting deep into a rocket motor development program, felt there would be a hazard in connection with the handling of a specialized fuel. They called in specialists from AMC who conferred with engineers, test stand technicians, fuel handlers and other project personnel. As a result, preventive measures were recommended, and there have been no accidents traceable to the dangerous fuel.

Sometimes there is little awareness that a hazard exists—because almost any job anywhere has its occupational hazards—until a near-accident focuses attention on a trouble spot.

Take aircraft oxygen systems, where you would expect that the greatest care would be used. At 10,000 ft., the crew of a ferry flight went on oxygen. In a few minutes, the co-pilot, using the aircraft supply, complained that he wasn't getting enough oxygen through the



**SPECIAL** coveralls developed by USAF protect workers from radioactive plane.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mask. Pilot and crew members were on walkaround bottles because of low system pressure. Shortly thereafter, the co-pilot collapsed; an alert crew member used a walkaround bottle to revive him.

The airplane was diverted for an emergency landing and carefully checked. Nitrogen was found in the plane's oxygen system. In spite of orders that the gas was not to be used, the system had been checked for leaks with nitrogen and refilling had apparently never been completed.

▶ **Radiation**—With everyone in the Air Force aware of the hazards of radioactivity, it is no wonder that the panic button was pushed in the case of a recent aircraft crash. The plane was carrying avionic equipment containing radioactive Cobalt 60.

A check was made of the radioactivity level by an industrial representative. He ventured the opinion that the Cobalt 60 was not nearly as much of a hazard as the luminescent marker rings on the circuit-breaker panel.

The medical service was asked to investigate. They set up simulated crash conditions by loading boxes with old tubes and old circuit breakers and dropping them on a concrete apron. They checked the radioactivity count before and after the "crash."

Their findings exonerated the marker rings on the panels. They pointed out that the luminescent paint contained radium, and the human tolerance to cobalt was about one million times greater than the tolerance to radium. Nevertheless, they said, it would be virtually impossible for a crew member to get a lifetime concentration of radium by breathing or swallowing in the low concentration typical of the crash.

▶ **Organization** – Problems of industrial medicine in general come under the Professional Services division, one of four groups directly under the Surgeon at Air Materiel Command. The other three groups are Medical Administration, the Dental Surgeon and the Veterinarian.

Professional Services is further broken down into five branches: Environmental health, laboratory, nursing, health education, engineering, and medical specialties.

The small and neat building of the environmental health lab houses a collection of problems under solution. The current list of projects being investigated includes:

• **Water Reservoirs.** Red lead paint is often used to preserve water reservoirs from rust. But minute quantities of the lead can be dissolved in water, and constitute a potential health hazard from lead poisoning. The lab wants to find out the degree.

• **Solvents.** Carbon tetrachloride and

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# Valve Talk

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by Marvin Miles,
Senior Member, Aviation Writers Assn.

**It's been a long time since any new aircraft has stirred up the comment — both pro and con — that whirls about the vertical rising fighter.**

**Some hail it as the greatest evolutionary achievement since the helicopter. Others say it's a fantastic dream that will pop like a drifting soapbubble.**

**I've talked to engineers who are itching to get into the field and to some who have no faith or interest in the VTO concept whatever — scoffers, in fact.**

My own reactions as a newspaperman were somewhat mixed at first. The Convair (XFY-1) and Lockheed (XFV-1) designs had an out-of-this-world aura that sparked the imagination and set up day dreams that were wonderful but not very substantial.

I wanted the VTO's to prove successful, of course, but I had little hope that they would. The idea behind them appeared as incredible as the Navy's development gamble was laudatory.

**This was all before I had seen Convair's Pogo Stick fly in a tether test at Moffett Field.**

Now I'm a "believer." I think the VTO's will fly like birds and land with the nimble grace of a ballerina.

And I'll wager anyone who has seen the XFY-1 go through her roaring mid-air dance in the big dirigible hangar at Moffett will go along with me.

It's hard to believe, but there it is – some six to seven tons of streamlined metal hanging on its props 50 feet above the deck, bellowing its anger at the bonds of the tether rig that gives it no lift, but simply keeps it from bursting through the hangar or crashing to the deck in case of engine failure . . .

**The Pogo stood squarely on the four points of her tips and tail, her nose pointing toward the hangar roof, when Test Pilot J. F. (Skeets) Coleman climbed the ladder and eased himself into the special cockpit seat inclined 45 degrees above horizontal.**

A few moments later the starter whined in increasing pitch until the Allison T-40 roared into life with a blast of blue smoke. The big contra-rotating prop blades turned sluggishly, then stilled while the ground crew cleared the area.

Suddenly Skeets engaged the blades and they whirled into a blur as the thunderous pulse of the engine beat at the hangar, shuddering the galleries and whipping up a light dust storm from the hangar deck.

Satisfied with his dials, the pilot increased Pogo's thrust just above the drag of gravity and the ship rose slowly, her hydraulic shocks lengthening under the lightened load until her four small wheels dangled just off the concrete.

**For a few heartbeats she seemed to dance, pirouetting just a bit, touching delicately several times until her props hauled her aloft — at perhaps three feet per second — to 50 feet where she hung suspended for long roaring moments like an up-ended helicopter.**

Not content with just hovering, Coleman put the Pogo through her routine, just as far as the conical tether lines would permit, swaying her adeptly this way and that, settling her slowly, then climbing her faster than a running counterweight could keep her nosebar taut, and it sagged sideways as proof that she was not pulled upward by her cables.

And the landing? Just as smooth as the takeoff. Like a helicopter. Or a sofa pillow. Skeets simply looked aft over his shoulder, set his thrust at a whisper less than gravity, and inched downward under full control – much like you would back a car into a garage.

The wheels touched lightly, jiggled somewhat. Then the shocks shoved inward and the Pogo rested her weight on the deck and sighed into silence.

Sure, there are problems ahead for this fascinating ship that can operate from a handball court – the unknowns of bending over into normal-attitude free flight, of backing down from greater heights – problems of wind effect and of heaving decks if the VTO is to fly from cargo ships.

**But from what I saw at Moffett, I'm convinced that Convair's Pogo and undoubtedly Lockheed's XFV-1, too — have it made, but good. At least, they'll show a clear path for improved successors.**

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benzene are no longer acceptable solvents in the USAF, unless they are the only solvents that can do a special job. The fumes of carbon tetrachloride are dangerous if breathed, and the material is also toxic by absorption through the skin.

• **Heavy metals.** Zinc chromate primers, selenium rectifiers, tetraethyl lead all contain heavy metals that are toxic in various degrees to humans. The lab is attempting to establish exposure limits for these potential hazards. They also check urine samples from people handling fuels containing lead to detect any onslaught of lead poisoning.

• **Anti-seize compounds.** There have been many complaints from crews about "bad-smelling" oxygen. The odors have produced nausea, vertigo and other such symptoms. Laboratory technicians have set up a simulated aircraft oxygen system in order to check for possible contamination of the gas by anti-seize compounds.

In spite of its workload, the lab is a small operating unit. They share a 1,800-sq. ft. building with the veterinarian, but have plans for a larger new lab building which will more than double their effective working area.

▶ **Teaching Techniques**—Health education is another facet of the medical task. All the preventive medicine is not going to do a bit of good unless personnel are convinced of its need and importance.

There may be a specific and special hazard to a group—for example, the technicians assigned to the overhaul of radioactive aircraft—which justifies special lectures and presentations to the group. During these sessions, they are told of the specific hazard, the proper use of protective equipment.

▶ **Silver Threads**—Starting now with middle-age groups, the Air Force is educating personnel in geriatrics, the subject of advancing age and its diseases.

There are many older people working for the Command, still useful and still physically fit. Their experience and abilities are a great asset to the USAF. The aim of the geriatrics program is to get younger people used to the idea of growing old gracefully, and to teach them what they can and can't do.

Technical letters are issued from the Office of the Surgeon which discuss a specific subject and recommend a procedure—if one is available—to guard against a particular hazard. Called "Occupational and Environmental Health Information Letters," these publications have dealt with such diversified subjects as jet noise, prevention of heat effects on personnel, siting of semi-portable engine test stands, hazards in aviation fuel handling and tank cleaning, and the hazards of burned-out selenium rectifier fumes. ■ ■ ■

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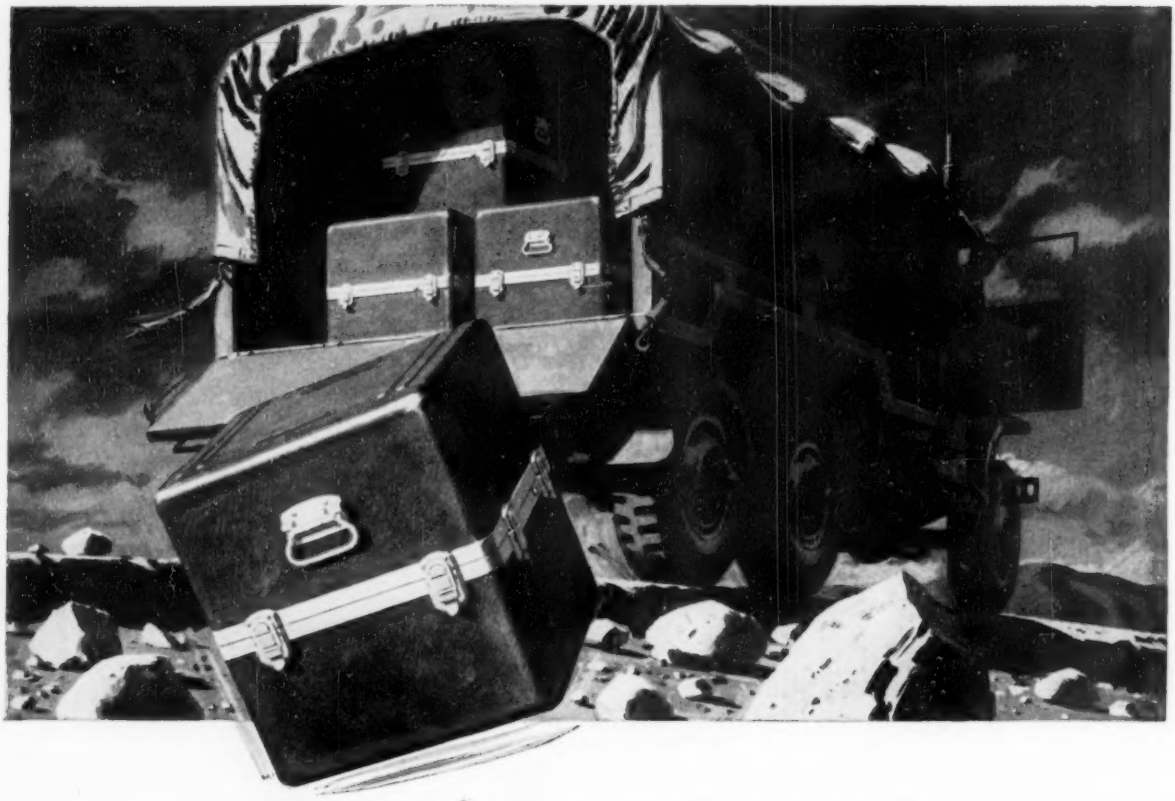

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More than 40,000 of these cases are now in use by the Air Force and Naval Bureau of Aeronautics all over the world. To date there has not been a single casualty to a case or the valuable equipment it contains.

This case has been dropped by parachute from a plane flying 250 miles an hour at 600 feet altitude (equivalent to a free fall of 25 feet), without damaging case or contents. It has been submerged in 40 feet of water without leaking. It will not dent or puncture. It is fungus and mildew proof. Vapor and moisture transmission rate is zero.

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# Gearing Industry For M-Day

To meet the threat of another war Air Materiel Command and its big partner, the aircraft industry, must have productive capacity standing on the shelf.

There must be skilled manpower, tools, raw materials, and factories, all geared for swift integration. When M-Day comes, we must reach peak output in a matter of months, not the four years that were required in World War II.

Col. Vincent T. Cannon, new Deputy Director/Mobilization Planning in the Directorate of Procurement and Production, faces three major aircraft industry mobilization problems:

• **Are the individual companies prepared for wartime expansion,** so that complex modern air weapons will roll off the production lines with minimum delay?

• **Are the aircraft companies taking adequate defense measures?** This includes plant dispersal away from target areas, use of protective construction and the licensing of secondary sources to spread technical knowhow around the country. In case of attack, swift rehabilitation is vital if a facility is all or partially destroyed.

• **How can the aircraft industry maintain existing capacity** in the face of production cutbacks? America has a lot of assembly lines, without the procurement dollars to keep them running at more than partial capacity. When industry loses money keeping the wheels turning or could make more money if they turned from more than one 8-hr. shift in a day, there is a strong incentive to close

## Plant Reserve List

USAF today has 107 factories on its Industrial Plant Reserve List. Acquired during and since World War II, most of them are in active production.

• 43 are owned by USAF and occupied by major weapons system contractors. Examples are the Ford plant in Chicago, Lockheed-Marietta and Convair-Ft. Worth.

• 52 are National Industrial Reserve plants.

• 12 are privately owned plants housing major projects or equipment that belongs to USAF. These include standby engine plants such as Packard in Utica, Mich., and Studebaker in South Bend, Ind. Equipment includes test cells, rail spurs, tank farms, altitude chambers, etc.

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down or get rid of military business. Butter frequently is more profitable than guns.

▶ **Techniques and Skills**—Chief AMC officer in charge of these problems was Maj. Gen. Kern D. Metzger, head of the Industrial Resources Division. In the general's opinion, techniques and skills are fully as important in achieving the mobilization goal as the assembly of men, tools and material in aircraft plants.

In addition to creating a reserve of production resources, Gen. Metzger said, "the highest degree of expansibility and producibility" must be built into present facilities of the aircraft industry.

Among the possibilities promoted under Metzger's regime and recommended to the industry are:

• **The heavy press program.** AMC sponsors the construction of large hydraulic forging and extrusion presses to speed output and improve the quality of aircraft parts.

• **Application of new materials,** such as titanium and plastics, where gains in weight, quality or ease of fabrication can be realized.

• **Automatic operation of machine tools** and general improvement in cutting speed and tolerances. In automatic production techniques, a machine tool is guided by a punched tape instead of a machinist. This has advanced to the point where AMC feels it warrants application to both present and improved machine tools, particularly spar and skin millers.

Faster cutting speeds and improved tolerances are needed to overcome a production handicap imposed by the tough steels and great precision demanded in jet engine manufacture.

Before the aircraft industry can understand fully why AMC pays money to expedite adoption of things like the heavy press program and automatic production, it must look upon mobilization planning as one of the missions of AMC. The objectives of this mission are, in the long run, drawn up to help industry meet its responsibilities.

▶ **Preparedness Mission**—The entire weapons system concept and the aircraft industry's role as prime supplier of both talent and hardware, will collapse at the time of America's greatest need if the mission and its objectives are neglected. The objectives are:

• **To make sure that the aircraft industry can do the job** in case of emergency. This applies to all levels of production—the weapons system contractor and his subcontractors, the associate contractor and the people who make GFAE.

• **To save all possible time when M-Day comes.** The goal is to have planning, stockpiling and licensing complete. It applies to matters that are current in

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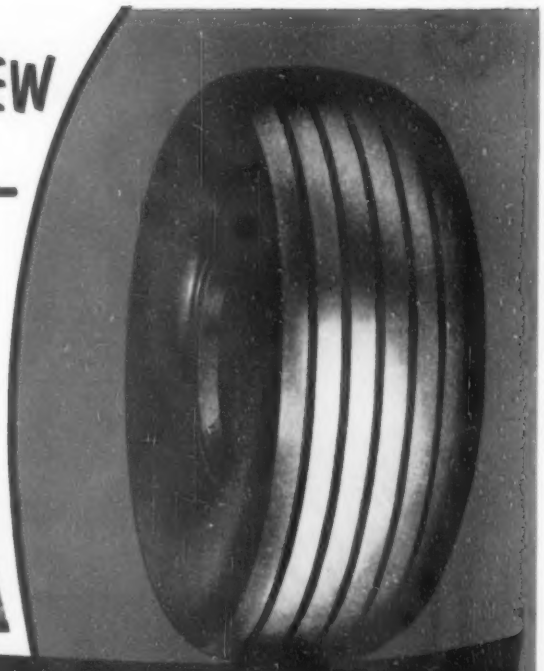

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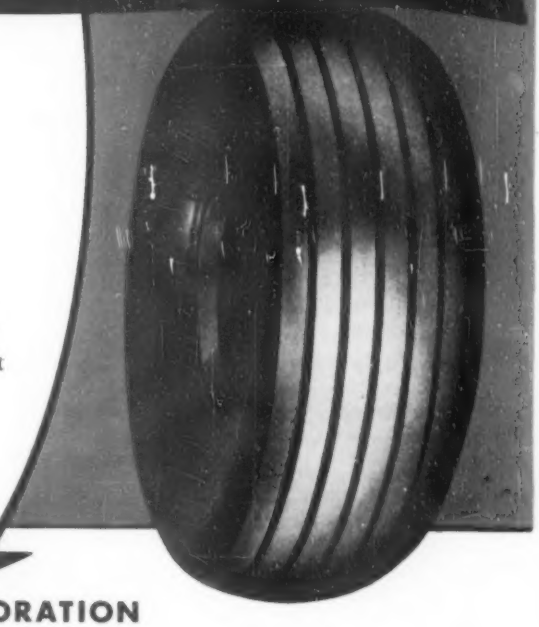

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## THE NIGHT BEFORE THE PROXY FIGHT

Harrison Wells settled himself in the comfortable seat of the company's newly-overhauled plane — *his* company's plane, he reflected. His company, too, for that matter. He had built it, at the first, by single-handed effort. Now, he was flying home to do battle for its control.

This year, a new group of stockholders was challenging him. The show-down was set for tomorrow — 10 A.M. in the company's board room. Harrison Wells patted the sleek side of his brief case. He thought of the neat pack of proxies he had rounded up in a hurried, cross-continent tour of some 5,000 miles.

Make *him* the chairman of the board — kick *him* upstairs? Not *this* year! The plane flew steadily eastward.

Flights of this kind can be quickly planned and safely completed if engines are routinely rebuilt by Airwork. The personalized service and the engine exchange program offered by this unusual organization make possible factory-new performance for the privately-owned plane. Nowhere else, except in the shops of large, scheduled air lines, will you find such production-line techniques, equal to those of the original manufacturer.

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every aircraft and component manufacturer's business: management, design, production engineering, tools, facilities, subcontracting and second source establishment.

• **To reduce the amount of damage,** as far as possible, that an enemy can do to the aircraft industry. Plans and programs must be laid out to cut vulnerability and restore as much production as possible and as soon as possible after an attack.

• **To keep America's strategic planning agencies fully informed** about what the aircraft industry can do in case of war, how well it can fill the order passed down from the National Security Council and the Joint Chiefs of Staff to USAF and AMC.

• **To make sure that the Air Force will get the weapons** it is counting on and there is no conflict with demands from the Army and Navy.

• **To provide facilities support for the current program.** Here is where plans to mobilize an aircraft plant at the outbreak of a war tie in with present procurement. A manufacturer of electronic gear who is permitted to devote all his capacity to television sets is not in a good position for swift conversion to military output.

► **Six Programs**—Aircraft manufacturers approached to help AMC meet these objectives and perform its mobilization mission, will make their contact under one or more of six programs.

• **Production Reserve Policy and Mobilization Production Base Program.** Here is where AMC acts to keep tools and factories ready to join the M-Day effort. The ones that are producing will have to speed output immediately. Idle tools and plants will go into production swiftly.

Obviously, this is the point where AMC's mobilization plans run head-on into successive stretchouts of production programs. During the Korean buildup, the problem was one of setting up bricks and mortar and filling the plants with machine tools. Now, in 1954, the big job is to let industry meet reduced production rates and keep the machines in mothballs.

From the viewpoint of both the aircraft or component manufacturer and AMC, the best possible situation would be to keep every machine in place and every plant open to start operations the minute the whistle blows. Costs, however, are prohibitive and Air Force Secretary Talbott says economic considerations are almost as important as the nation's state of preparedness.

America can't afford to house the aircraft industry and supply it with tools unless something rolls out of the hangar doors or off the assembly line.

For this reason AMC, under the Production Reserve Policy, has its choice of four things it can do with USAF

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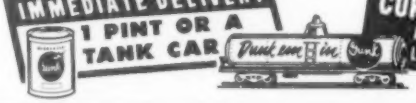


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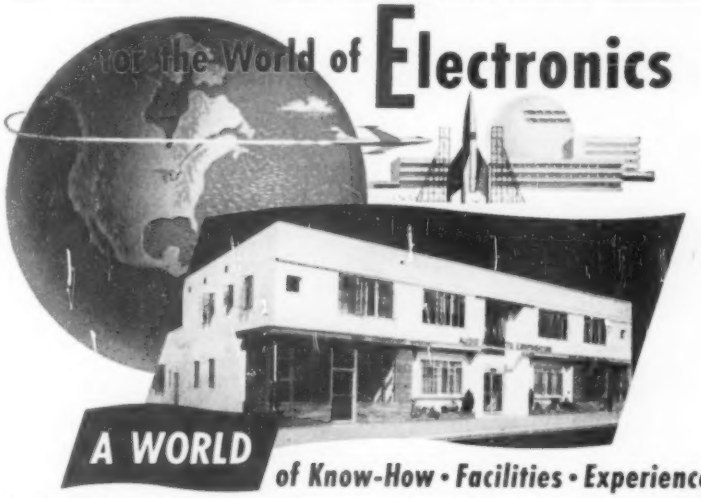

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## ■ PRODUCTION

machine tools and equipment as production rates are cut back:

- It can leave them where they are, in place on the factory floor.
- It can use "on site" storage for items removed from the production line, but left in the plant.
- It can move them to a warehouse adjacent to the factory.
- It can move them to a central government storage site.

Disposition of a particular plant's equipment depends on how important these tools will be on M-Day. Priority is dictated by preparedness requirements, tempered by cost.

- **Preparedness Contracting Program.** Under some circumstances, AMC will give an aircraft or component supplier a contract to pay him for his work in preparation for M-Day. In the past seven years about 250 preparedness contracts have been made, with a total value amounting to approximately $35 million.

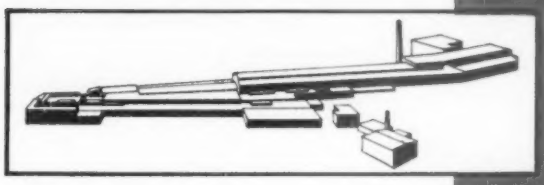
Preparedness contracts provide these things for AMC:

- "Capability determinations" in key industries. These are production plans, each one setting an objective of a given number of units. The timetable is complete with details of plant layout, manpower needs and a breakdown on subcontracting.
- Redesign of many products so that they can be produced in higher volume.
- An accurate census of the resources that will be needed by an aircraft or component manufacturer to meet a wartime production schedule.
- An accurate record of license agreements between prime and secondary sources on critical items. Here AMC must be certain that there is free interchange of technical data. No secondary source can be left without the latest information on the product and the way it is made.

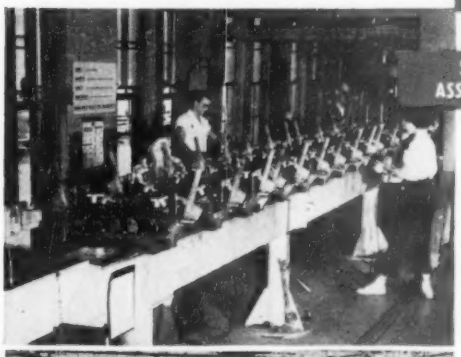
Licensing is particularly important in maintaining productive capacity for engines at secondary sources. For example, backstops are provided for Pratt & Whitney at Ford and Nash. At the Nash plant, production is phasing out on the R2800 engine and the machine tools are being placed in storage, earmarked for M-Day return to Nash.

Meanwhile, the Nash plant will continue to hold its license to make the R2800 and the technical assistance agreement will be continued, though passive. Nash will continue to receive up-to-date engineering data and stay abreast of P&W methods. Ford is shifting to the J57 and remaining in production.

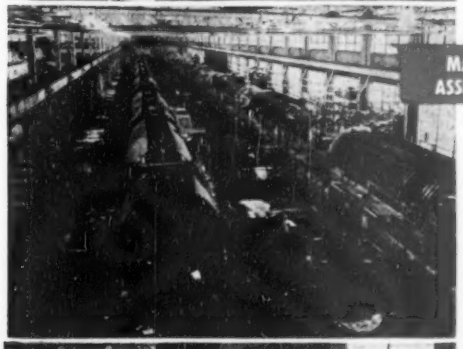
- Assurance that secondary or alternate sources will not be without technical data and specifications even in the absence of a license agreement. This is achieved by having duplicate informa-



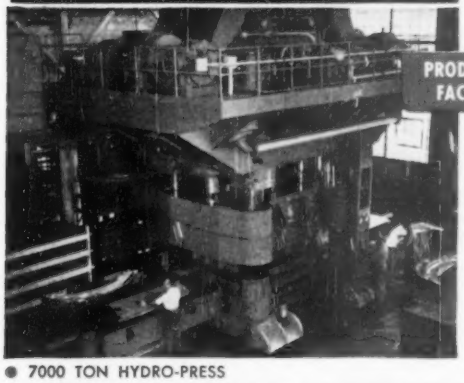
# SPEAKING OF PROGRESS



SUB ASSEMBLY



MAJOR ASSEMBLY



PRODUCTION FACILITIES

OLIVER Aviation's contribution to the progress of aircraft construction is a matter of record.

Within seven months this large, modern, and diverse manufacturing plant was completely staffed and equipped. At the same time production planning, tool fabrication and final assembly of a major aircraft component were achieved.

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- — developed the ability to produce on schedule.
- — achieved and maintained a high standard of product quality.
- — established an enviable cost reduction record.
- — and at the same time received two National Safety Council awards for plant safety.

To achieve this goal it was necessary to develop an organization consisting of progressive personnel and specialized equipment. A few of the facilities available for aircraft construction are shown here.

The production "know-how" developed by Oliver Aviation is available to solve your production problems.

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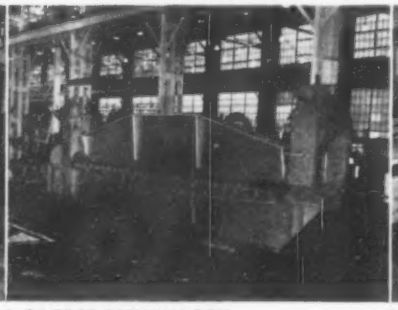
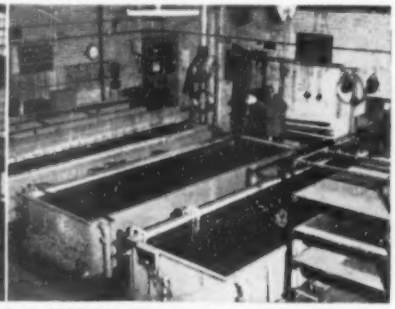


● 24 FOOT FARNHAM ROLL



● A SECTION OF THE HEAT TREAT AREA

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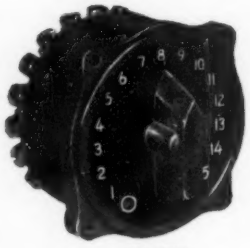
**FOR RESISTANCE THERMOMETERS AND THERMOCOUPLE THERMOMETERS**

**EACH SWITCH HAS "OFF" POSITION PLUS NUMBER OF POINTS LISTED.**

| Points | Size | Switch Part Numbers Thermocouple Type | *3 Wire Resistance-Thermometer Type |
|---|---|---|---|
| 2 | 2" | 11S2 | 36SR2 |
| 3 | 2" | 11S3 | 36SR3 |
| 4 | 2" | 11S4 | 36SR4 |
| 5 | 3" | 10S5 | 37SR5 |
| 6 | 3" | 10S6 | 37SR6 |
| 8 | 3" | 10S8 | 37SR8 |
| 9 | 3" | 10S9 | 37SR9 |
| 10 | 3" | 10S10 | 37SR10 |
| 12 | 3" | 10S12 | 37SR12 |
| 16 | 3" | 10S16 | 37SR16 |
| 18 | 3" | 10S18 | 37SR18 |
| 20 | 3" | 10S20 | 37SR20 |
| 24 | 4" | 27S24B2 | 38SR24 |
| 28 | 4" | 27S28B4 | 38SR28 |
| 40 | 4" | 38S2C | |

*Resistance thermometer switches are provided with a safety resistor on off position.

2" SIZE



3" SIZE

### SPECIAL SWITCHES

No. 37S6C2, Four "4 Point and OFF" thermocouple switches combined in one 3" case.

No. 9S5, Single Pole, Four Point Instrument Switch in 1¼" round case.

No. 44S4, Six Pole, Double-throw Instrument Switch in 2½" round case, one hole mounting, ½-32 threaded bushing.

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tion safely stored for use in event that the primary supplier's records are completely destroyed.

• **Producibility Program.** Here again, contracts are issued to cut the time and cost of producing USAF equipment in event of an emergency. There are at present 74 contracts in existence with a value of about $27 million.

These contracts are designed to eliminate possible mobilization bottlenecks, and include such things as automatic tools and faster cutting speeds. The contracts have as their purpose:

• A reduction in the number and quantity of critical materials that would be needed in event of war.

• The design of special-purpose machine tools and equipment.

• The development of more efficient production methods.

• The redesign of articles for high-volume production.

• **Industry Defense Program.** The goal here is to protect aircraft and component plants, disperse their facilities wherever possible and provide for getting them back in operation if they are damaged by the enemy. Here is what AMC does to carry out the program:

• Key facilities are inspected annually and suggestions made to the managements that will improve their security. Compliance is voluntary.

• Contracts have been signed with 52 companies in the aircraft field calling for a study of what would be necessary to resume production after enemy attack. These analyses by industry management will presume varying degrees of damage to their facilities from any source. They will result in recommendations for action by both management and government. The results will be distributed to all industry.

• Under a Department of Defense directive, AMC now requires a review of any plant under consideration for a contract of more than $100,000. The study must consider the factory's location in reference to target areas such as centers of population, industry or military installations. The location is considered as a factor in determining award of contracts. However, AMC admits, location and plant dispersal so far have been overshadowed by such things as price, ability to deliver and the labor supply.

• **Production Allocation Program.** As in the case of plant dispersal, the Department of Defense lays down procedures. The department's aim is to make sure that all branches of the Armed Forces are in step when they deal with defense industries. The program is directed by Thomas P. Pike, Assistant Secretary of Defense for Supply and Logistics.

The Production Allocation Program does these things, which guide AMC

in its dealings with the aircraft industry:
• Schedules wartime production requirements for the entire Defense Dept.
• Develops plans for war conversion of industrial capacity.
• Effects unified and coordinated planning for the Army, Navy and Air Force.
• Distributes and allocates production capacity among the three armed forces.
• Integrates mobilization programs and current procurement to provide a base for rapid expansion.

Since November 1950, AMC has vouched for the merits of more than 1,200 applications for Certificates of Necessity to speed amortization of aircraft plant construction. The result has been an investment of $995 million of private capital in new facilities that will turn out USAF materiel.

Since June 1950, AMC has awarded 480 contracts that permit aircraft and component manufacturers to build or buy buildings and equipment for USAF. Total cost of these projects has been about $2 billion. As a general rule, AMC collects no rent for these plants but takes the circumstances into consideration on the price of the product.

• **Heavy Press Program.** This multi-million-dollar Air Force program is paying for the creation of huge presses that will squeeze out and forge mammoth one-piece parts for high-performance aircraft. It will simplify many aircraft structures, provide important savings in weight, and speed fabrication.

▶ **Korean 'Dry Run'**—AMC's industrial mobilization specialists call the Korean war a "real dry run."

USAF had a mobilization plan before Korea, but the deficiencies disclosed since 1950 have resulted in a set of recommendations now under consideration at the highest levels in the Defense Dept.

Big weakness of the pro-Korea plan was that it did not provide standby capacity in the aircraft industry. The buildup took much longer than AMC expected.

AMC's industrial mobilization program is dynamic in nature and always is in a state of flux. The reason is that weapons system configurations and capabilities change so fast that new factors never cease to enter the mobilization picture.

In the event of an atomic war on the United States, AMC now must be ready with new production weapons. It is clear above all else that most of these must come from improved technology, applied in standby factories and with available labor. The improved methods, like a minority vote, may swing the balance of power.

Only special equipment and special talents, AMC feels, can prevent a production bottleneck. We can't wait again for Rosie the Riveter. ■ ■ ■

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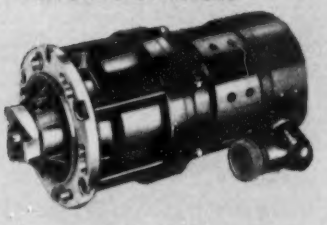

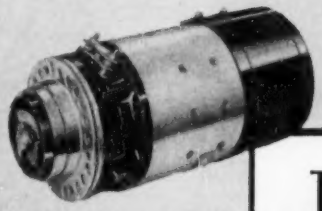

GAS TURBINE
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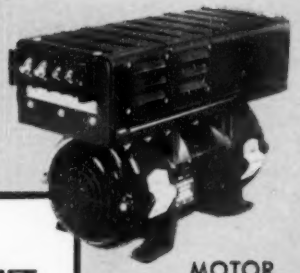
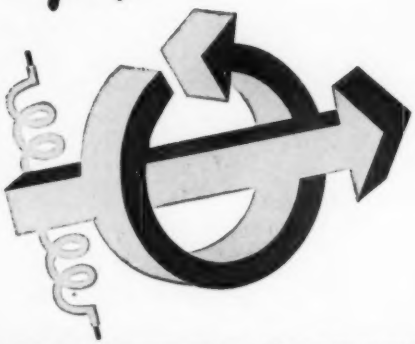


MOTOR
GENERATORS

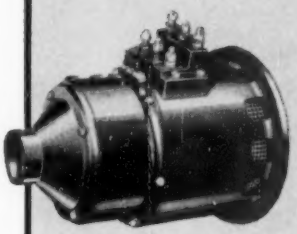
# JACK & HEINTZ

## Rotomotive

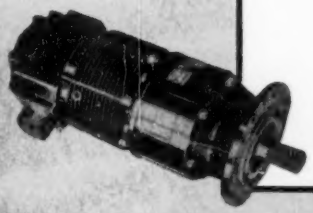


# EQUIPMENT

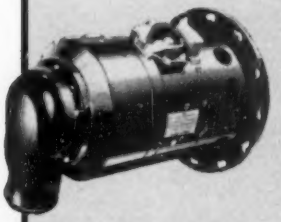
TACHOMETER
GENERATORS



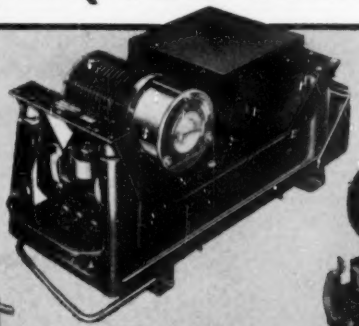
A-C GENERATORS



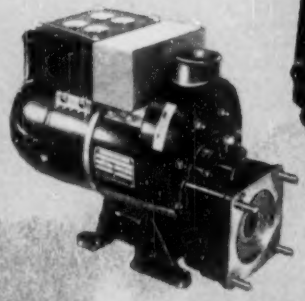
ROTARY ACTUATORS



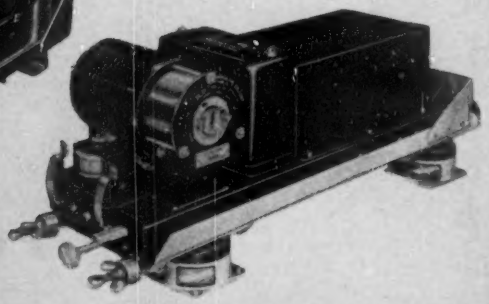
GENERATORS



GC34-2 STANDARD
SYSTEM



AIRCRAFT MOTORS



GC18-1 PANELED
ELECTRICAL CONTROL SYSTEM

## JACK & HEINTZ · INC.
CLEVELAND 1, OHIO

**TWO OUT OF THOUSANDS,** these mechanics symbolize the task of maintenance in the United States Air Force.

**■ MAINTENANCE**

# Making New Airplanes Out of Old

**A billion dollars a year makes new airplanes out of old ones. It keeps the materiel of the United States Air Force reliable, operational and modernized.**

**Thousands of people work in maintenance. They do a myriad of jobs, from replacing a broken safety wire to rebuilding and modernizing a giant bomber.**

**These jobs may be done in the desert or in the Arctic by a mechanic with a kit of hand tools. They may be done on a sprawling factory floor dotted with machinery and scarred with conveyor tracks. But always these jobs are done; they have to be, because planes on the ground can't win a war.**

**The skill of the pilot is useless unless it is backed up by the skill of the riveter and the welder. Strategic planning of Headquarters, USAF, comes to nothing if production control of maintenance breaks down. The file clerk, the painter and the floor sweeper are all part of the long line that starts with inanimate metal and ends as a winged sculpture.**

**The jobs they do in maintenance are sometimes routine, sometime extraordinary, sometimes unglamorous. But always they are done, because they are important jobs.**

**Other people design airplanes, others build them and still others fly them.**

**But maintenance keeps them flying.**

# Keeping Them Flying Is Big Business

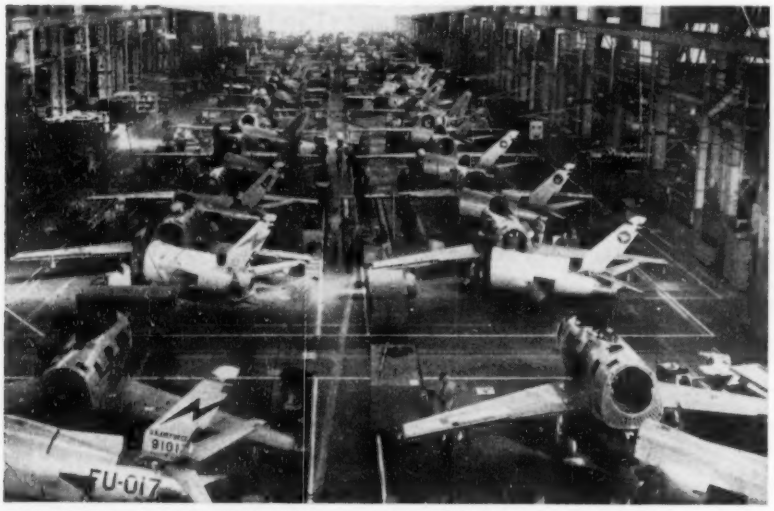
By David A. Anderton

**Maintenance is big business in the United States Air Force. In round numbers, it takes a billion dollars each year to keep the materiel of the Air Force reliable, operational and modernized.**

**About 66,000 persons work in the 12 decentralized facilities of the Air Materiel Command's Directorate of Maintenance Engineering, doing the myriad of jobs from cotter key replacement to the complete rebuilding of a complex turbojet.**

Pyramiding up from the solid base of the Air Materiel Areas (AMAs) and the specialized depots is an infrastructure of management, sprawled out among the pillars and posts that mark the office space in the AMC headquarters buildings at Wright-Patterson AFB.

On these managers and their counterparts at the 12 "divisions" rest the responsibilities of a billion-dollar business which is operating to save money, but not to show a profit. These are the men who must plan and schedule so that the Directorate can truly produce "More Air Force per Dollar."




**F-86 LINE** at McClellan AFP Calif., was converted from B-29 overhaul during last year.

**B-47S IN IRAN** are on the first station of major overhaul line at Tinker AFB, Okla.

▶ **Job Definitions**—The function of the Directorate of Maintenance Engineering is to keep USAF materiel in a maximum state of operational readiness and dependability to support USAF objectives.

But the Directorate has added responsibilities:

- **Evaluation and programming** of effective maintenance engineering for the Air Force.
- **Coordination on design specifications** with ARDC to see that easy maintenance is built into new designs without compromise of performance.
- **Provision of technical assistance** to the entire Air Force and to the forces of the MDAP countries.
- **Determination of the maintenance scope**—in collaboration with the major air commands—to be performed at organizational, field and depot levels.
- **Accomplishment of maintenance** requirements that exceed the capabilities of using organizations.

▶ **Main Functions**—There are three main functions performed in USAF maintenance:

- **Periodic inspection** to check equipment reliability.
- **Repair and overhaul** to keep equipment operational.
- **Modifications** to correct deficiencies or to change capabilities.

This kind of work could be done in the old days by ground crews with minimum facilities and equipment. It was easy to improvise. The stories of wars are filled with tributes paid to mechanics who maintained aircraft in jungles and deserts, using hand tools and hastily built fixtures.

But complexity in design and performance reflects in complexity of maintenance. The tools get specialized, the facilities get larger, the workers need more skills. The engine test cell that cost $20,000 at the beginning of World War II was perfectly adequate for smaller reciprocating engines; today, its counterpart for large jet engines costs 30 times as much.

Maintenance is big business. So the Directorate has been studying and applying wherever possible the methods of scientific management and planning that have been adopted by industry. These powerful new management tools are already pointing the way toward more economical maintenance and more effective use of the facilities and labor force at hand.

## Work Measurement

Behind any work program is sched-

uling and planning; the wheels of industry begin to turn long before any products start coming out the front door. Ideally all a factory manager could hope for is a clear projected workload. With that knowledge, he can ask for money, materials and manpower and be sure of coming very close to his actual requirements.

▶ **Workload Forecast**—"What we'd like to be able to do is to estimate our workload about one or two years ahead," says Maj. Gen. Carl A. Brandt, who heads the Directorate. "We'd like to be able to build up data like the automobile flat rate manual for repair, where you can just look in a book and get a reasonable time estimate to do a job."

This kind of work-standardization is never an easy task, and in maintenance it is even harder for this basic reason: Products and job varieties are extreme.

Through the hangar doors pass fighters, transports, helicopters, tankers, trainers with piston engines or jet engines, and with or without complicated avionics equipment and control mechanisms. An aircraft may need a simple overhaul or it may be a basket case and need complete rebuilding.

▶ **Study Financed**—In the face of conflicting arguments as to whether or not it was possible to establish work-measurement standards for maintenance, AMC requested the Management Services Division of Ernst & Ernst, Cleveland firm of certified public accountants, to study the situation and come up with standards that would be acceptable. Ernst & Ernst set up its operations out of the firm's New York office and began the pilot one-year study.

Last April the one-year contract was completed; Sacramento Air Materiel Area (SMAMA) had been chosen as the guinea pig, and work standards had been determined and applied there.

Overall work efficiency at SMAMA was about 54% in August 1953; by December the figure had been brought up to 65%.

There is a dollar yardstick to assess the value of those percentage increases. At SMAMA, one percent improvement is about $300,000 per year saved.

▶ **What Is a Standard?**—The work standard has been defined in this way:

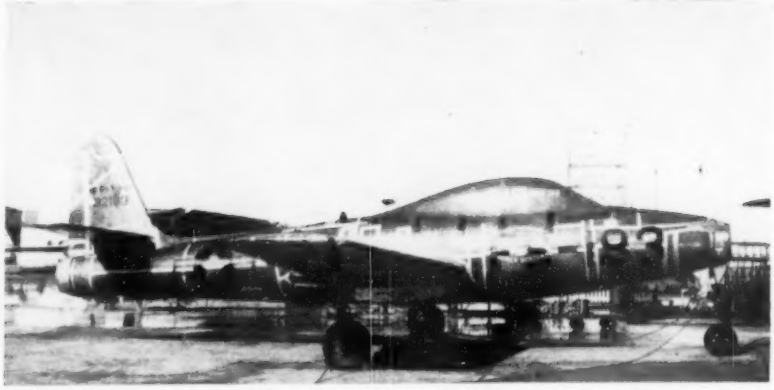
**Time required by an average worker to do a job while working at a normal pace under actual conditions which exist when the standard is applied.**

Once determined, the standards must be approved as attainable by the supervisor of the department concerned. It might also be pointed out that no one expects a worker to produce every minute of the day; the standards are adjusted to allow for

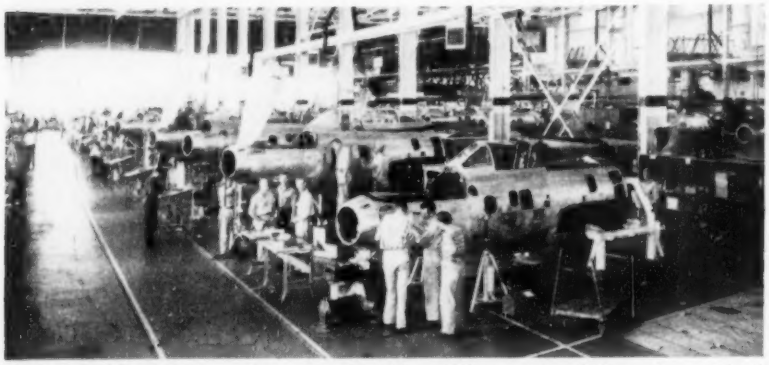
**FLIGHT CHECK** of F-86 is last step in McClellan AFB maintenance before shipping.

**MINOR REPAIRS** are done by mechanics in base and transient section, Olmsted AFB.

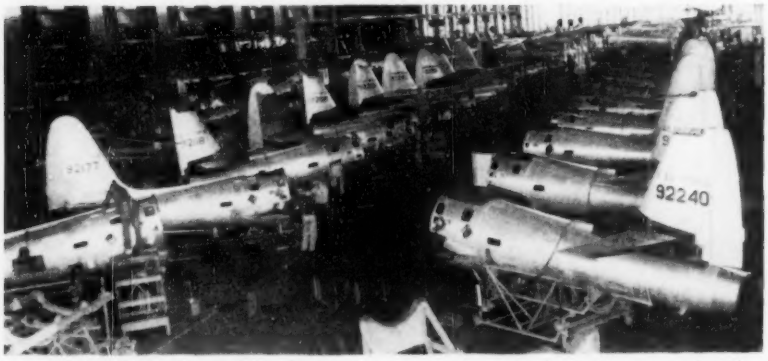
**OVER THE SIDE** comes a returned F-84 for overhaul at Brookley AFB, Mobile, Ala.



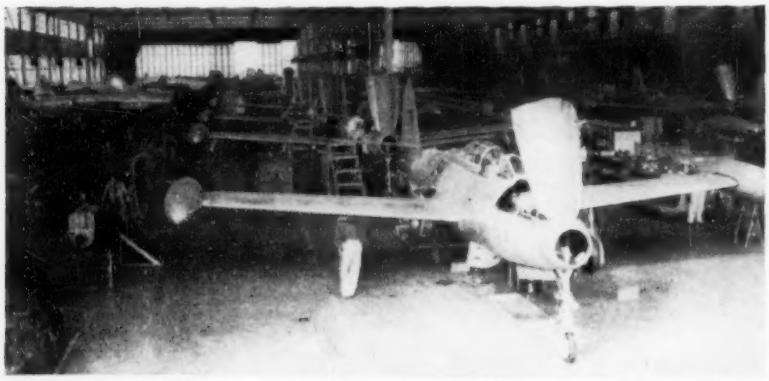
**PLASTIC OVERCOAT** covers Republic F-84 for corrosion protection during shipping.



**FORWARD FUSELAGES** on the line at Brookley AFB are stripped for major overhaul.




**AFT FUSELAGES** of Republic F-84s get the major overhaul treatment at Brookley.



**THREE IN TWO DAYS** is rate at which these Thunderjets come off the overhaul line.

restroom time, fatigue and unavoidable delays.

These standard times are then multiplied by the planned unit output of the work center to arrive at a standard-hours figure, or the so-called "earned hours." Weekly or bi-weekly reporting compares the earned hours with the actual payroll hours logged in the work center.

The ratio of earned hours to total hours then measures the efficiency of the work center.

▶ **No Speedup**—It is important to understand that these are not "speedups." The figures mean that the worker's effectiveness is being increased, while he continues to operate at his usual pace (assuming he's an average worker).

The difference is brought about through improved shop layout, better tools and fixtures along with better management.

There is an improvement in production control with work measurement standards. The scheduling of work in and out of the shops can be better planned because the controllers know where men are needed, where sections are overstrength.

The function of cost distribution and cost control is simplified because:

- **Material standards are also set for each job by production control.**
- **Industrial engineering knows how much labor will be required.**
- **Accounting can allot overhead proportionately to each job.**

▶ **Examples**—Specifically, here are a pair of accomplishments at SMAMA to illustrate the value of the work-measurement program:

- **R4360 engine overhaul:** From January to June 1954, man-hours per engine were reduced from 1,050 to 700, and the number of personnel assigned cut from 1,040 to 943. Earned hours increased from 57,411 to 62,020, an increase corresponding to the work of 55 extra persons under the old system. As a result, less men did more work and the 97 workers no longer required

# NEW HEADQUARTERS for LONG RANGE FLIGHT

Here beside the long runways of Baltimore's Friendship Airport is the brand new Flight Refueling plant, designed and constructed by Flight Refueling for the development and manufacture of Probe and Drogue refueling systems for the Armed Services.

Now in full operation, this new Flight Refueling facility is turning out in increasing numbers the Probe and Drogue refueling equipment which made possible the first non-stop transatlantic jet flight, the first refueled combat operations and the first jet to jet aerial refueling.

And from the Flight Refueling laboratories new systems of higher capacity and efficiency are being developed.

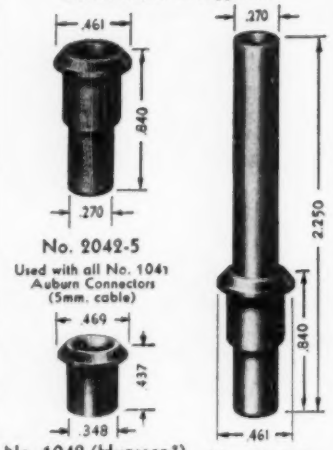
Aviation can take satisfaction that this new plant—devoted to *long range flight*—is now in full operation.

*Flight Refueling, Inc.*

FRIENDSHIP INTERNATIONAL AIRPORT
*Baltimore 3, Maryland*

Auburn
IGNITION
ACCESSORIES

Terminal
Collars (Seals)
Ozone Resistant Hypreen*




No. 2042-5
Used with all No. 1041 Auburn Connectors (5mm. cable)

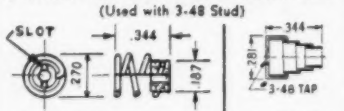



No. 1042 (Hypreen*)
No. 1043 (Silicone)
Used with all No. 1041 Auburn Connectors (7mm. cable)

No. 1042-5
Used with all No. 1041 Auburn Connectors (5mm. cable)

*Auburn Synthetic Rubber

SPRING AND EYELET ASSEMBLIES
(Used with 3-48 Stud)



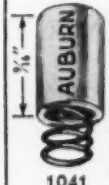

No. 1066-9A (AN 4164-22) with stainless steel coil springs

No. 1066-9V with Inconel volute springs

Teflon
Connectors
with Inconel volute springs

1041-TV (9/16")
1099-TV (1")

Connectors with stainless steel coil springs

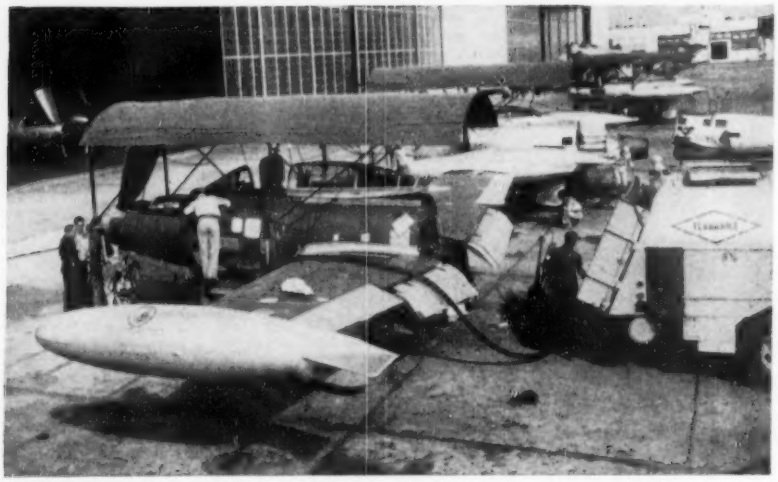



1041-C Steatite
1041-M Mycalex
1041-D Alumina
(AN 4164-2)

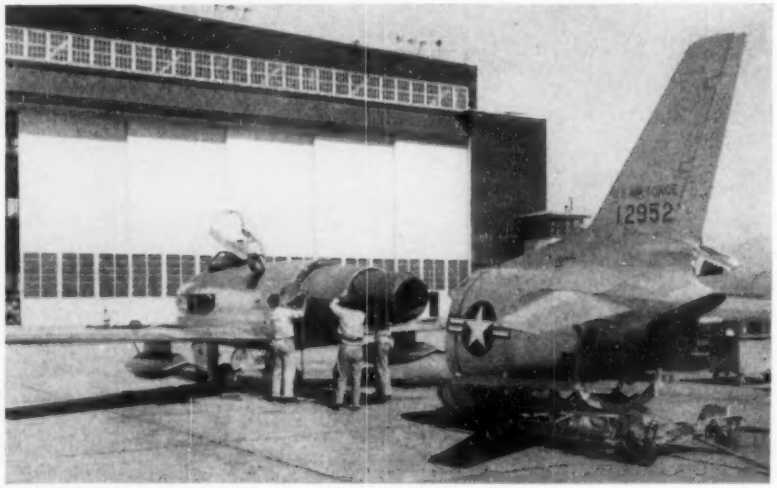
1099-C Steatite
1099-M Mycalex
1099-F Phenolic
1099-D Alumina
(AN 4164-1)

1041 1099

AUBURN SPARK PLUG
Co. Inc., Auburn, N.Y.



**OUTDOORS CHECK** of F-84 forward fuselage is one of last steps in overhaul.




**PLANE DIVIDED,** mechanics work on J47 jet in F-86D fighter.

in this section were transferred to the aircraft shop where the labor force was badly needed.

• **Wing-tank repair:** The national average of hours required at all the AMAs was 25, but SMAMA showed up with a 20-hr. figure. Study of the operation produced a standard of only eight and one-half hours, which astounded the supervisor; he thought he'd been doing well to keep five hours under the standard. But they gave it a try, and soon began to hit close to 100% effectiveness.

A recheck of the job showed that the supervisor had made improvements in the method of operations, and so the job was restudied and a new standard of 4.9 hours was set. At last report, the foreman was up to more than 70% effectiveness on this new, lower figure.

This example illustrates the two phases of work improvement. First, the job of tank repair was improved by setting a new standard for the job, using the methods traditionally applied to the job. Second, the methods were improved so that the standard could be further lowered.

This work is now being carried on by the Industrial Engineering division at SMAMA and is expected to be fully operative throughout AMC in about two years. Standards studies will continue, because new aircraft and engines will be coming along.

Meantime, the original contract with Ernst & Ernst has been amended to include studies in the fields of production control and in cost accounting and payroll distribution systems. These will, when successful, be fed into the rest of AMC.

## Actuarial Methods

One of the more fascinating studies in the Directorate is how old engines die. Knowing when this happens, logistic planning becomes easy.

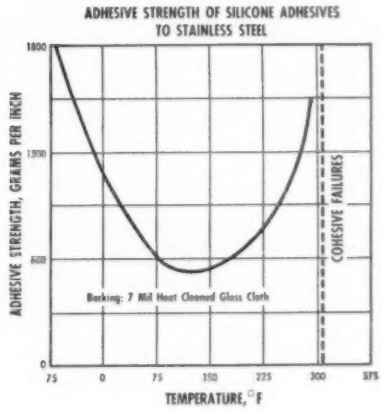
Like a human being, an engine is

DOW CORNING **Silicone News**

August, 1954 • PUBLISHED BY DOW CORNING CORPORATION, MIDLAND, MICHIGAN

## New Pressure Sensitive Silicone Adhesives Stick To Most Surfaces; Retain Their Excellent Adhesive Strength From -55F To Over 250F

The newest products to come out of our development laboratories are pressure sensitive silicone adhesives that stick to almost any materials including silicones and Teflon. Adhesive strengths in the range of 1800 grams per inch at —55 F and over 1200 grams per inch at 265 F, are far superior to those of conventional pressure sensitive tapes. The adhesive strength between a stainless steel surface and glass tape coated with silicone adhesives is plotted against temperatures ranging from —75 to 285 F in this Figure.



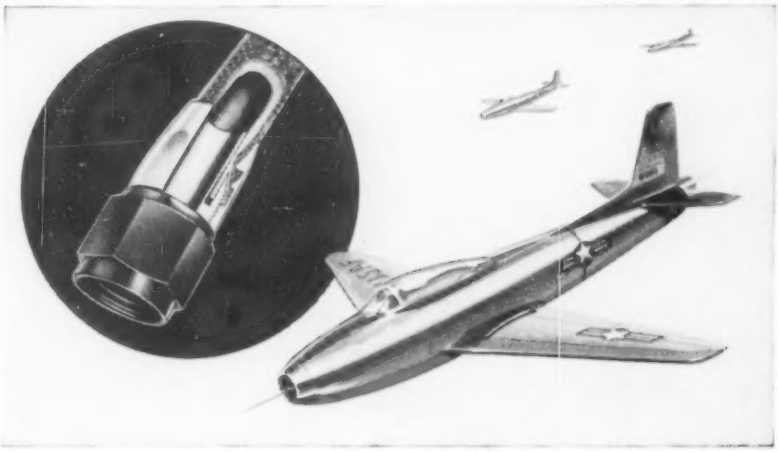

Uses for tapes coated with silicone adhesives include high temperature electrical and electronic applications; weather and moisture resistant wrapping and sealing tapes for low temperature applications. One electrical equipment manufacturer is already using these pressure sensitive adhesives to bond mica matt and integrated mica to glass cloth. *No. 1*

## Silicone-based Aluminum Paints Outlast Organic Finishes 10 to 1 at Sterilizing Temperatures

Trays containing vials of aureomycin and other antibiotics at the Lederle Laboratories Division of American Cyanamid Company are loaded onto racks and sterilized for 3 hours at 446 F to destroy pyrogens.

The organic aluminum finish on these racks began to crack and peel, permitting rust to form, after 9 to 15

(continued page 2)



## Flexible Silastic* Tubes Carry Air at 500 F; Prevent Engine Failure Due to Icing Over Jet Air Scoops

**Reinforced with stainless steel braid, Silastic tubing requires minimum space; endures heat and high frequency vibration.**

It was discovered shortly after certain jet engines were put into service that the formation of ice over air intake scoops could choke off the air supply and cause engine failure.

The obvious solution to this problem was to pipe air at 500 F from the compressor to the scoops. But that simple solution involved many problems.

The jet engines were so tightly fitted in their nacelles, that very little room was left for hot air ducts of any kind. High frequency vibration set up by the engine and plane introduced the problem of fatigue failure.

This was a job for a flexible tubing, a tubing that could carry hot air without melting, withstand the vibration and permit fast and easy assembly and disassembly. Engineers of the Aeroquip Corporation of Jackson, Michigan, solved the problem with flexible Silastic tubing. Reinforced with stainless steel braid, Silastic tubing is light and flexible. It is held mechanically to the stainless steel braid so tightly that the tube will not collapse even when subjected to a vacuum.

The high temperature problem of attaching a fitting to the hose was ingeniously solved by the new Aeroquip "Little Gem" fittings. The total assembly proved to be so effective that these anti-icing hoses have become standard equipment.

Despite internal and external temperatures as high as 500 F, the Silastic hoses are still in excellent condition after hundreds of hours of service. Aeroquip has supplied thousands of them to jet manufacturers. From 5 to 20 are required per engine, depending upon its design.

The usefulness of Silastic in this application confirms data collected by our development engineers on effects of accelerated aging at high temperatures on the properties of Silastic. Heat resistant organic rubber becomes brittle in a few hours; Silastic 80 does not crack on flexing over a ⅜ inch mandrel, and hardness increases only 9 points after more than 670 hours of continuous aging with all surfaces of the test sample exposed in an air circulating oven at 480 F.

Silastic 80 readily meets SAE-ASTM Specification TA805 which requires that it have a minimum tensile strength of 500 psi; a minimum ultimate elongation of 50 percent. After 70 hours aging in an air oven at 450 F, increase in hardness is not more than 15 points; drop in tensile strength is less than 25 percent and loss of ultimate elongation, less than 40 percent.

In oil resistance tests, decrease in hardness is less than 45 points; increase in volume, less than 60 percent after 70 hours immersion in ASTM No. 3 oil at 300 F. After 70 hours immersion in ASTM No. 1 oil at 300 F, loss in tensile strength and ultimate elongation is less than 20 percent; decrease in hardness,

(continued page 2)

*T. M. REG. U. S. PAT. OFF.

FOR DATA RELATING TO THESE ARTICLES, CIRCLE REFERENCE NUMBER IN COUPON ON NEXT PAGE

MORE

DOW CORNING SILICONE NEWS PUBLISHED BY DOW CORNING CORPORATION

## NEW DEVELOPMENT AND TECHNICAL DATA

For copies of any of the publications reviewed in this column or for data relating to any of the articles printed in this issue of the Dow Corning Silicone News, simply circle the corresponding reference number on the coupon below.

Expansible resins. Two new silicone resins, Dow Corning XR-543 and XR-544, can be expanded to produce heat-stable, non-flammable, unicellular foams with densities from 8 to 24 lbs per cubic foot. Highly resistant to thermal shock, these silicone foams show practically no structural or dimensional change after 20 hours at 700 F. Weight loss after 220 hours at 570 F is less than 2%; moisture absorption less than 0.05% after 7 days at 96% RH. Resins are easily foamed in place, made up as sandwich structures or machined with wood working tools. *No. 5*

•

Dow Corning 1109, a durable new silicone water repellent treatment for leather footwear, gloves, luggage and sporting goods; minimizes water absorption and transmission; improves resistance to oils and chemicals without changing the "breathing" characteristics of leather. *No. 6*

•

Now available, the new 1953-54 Reference Guide to Dow Corning Silicone Products summarizes properties and applications for commercially available silicones. A complete revision of previous guide which some designers have reported to be one of the most helpful catalogs ever produced. *No. 7*

•

Silastic 6-127 paste, an excellent cloth coating material and bonding agent for silicone rubber, retains good dielectric properties over a wide range of temperatures and frequencies. It has superior resistance to heat and moisture; remains flexible down to — 100 F. *No. 8*

•

"Tall Tales and Fabulous Facts" is a new 24 page booklet built around the idea that, in our times, the tallest tales are told in technical terms. In this publication, the tall tales our ancestors told about such legendary characters as Paul Bunyan, Davy Crockett and Pecos Bill are related to some equally fabulous facts about Dow Corning silicone products. *No. 9*

•

Air drying silicone water repellent for application to glass, plastic and ceramic insulator bodies and to electronic parts and components maintains high surface resistivity under humid conditions; minimizes adhesion of dirt and chemical dust; reduces maintenance. *No. 10*

**DOW CORNING CORPORATION - Dept. DI-20**
Midland, Michigan

*Please send me:* 1 2 3 4 5 6 7 8 9 10

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TITLE _____

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## Small Electric Machines and Electronic Parts Can Now Be Designed to Operate at 180 C.

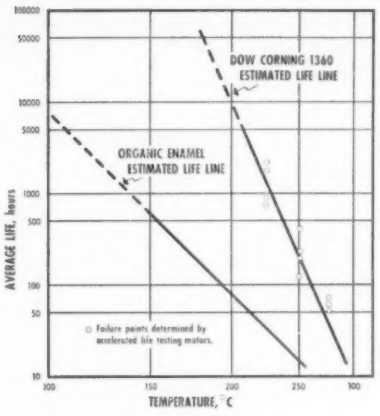
Life and reliability can be increased, or the size and weight of electronic devices and fractional or miniature motors can be reduced through the use of bare magnet wire insulated with Dow Corning 1360 Wire Enamel

Flexibility, scrape hardness and dielectric strength compare favorably with those of the best organic wire enamels. Dow Corning 1360 coated wire also shows superior resistance to a wide variety of solvents, oils and salt water.

The results to date of the accelerated life testing at temperatures in the range of 200 to 275 C of several electric motors wound according to standard commercial procedures with 1360 coated wire are plotted in the chart at right.

These data show that motors wound with magnet wire insulated with Dow Corning 1360 Wire Enamel have a life in the range of 1500 hours at 225 C (437 F), compared with 30 hours for identical motors wound with the best grade of Class A wire.

Based on the results to date of this motor test program, we expect that the life of machines wound with 1360 coated wire at 180 C will be comparable to that of identical machines wound with conventional Class A wire at their maximum operating temperature of 105 C.


DOW CORNING 1360 ESTIMATED LIFE LINE
ORGANIC ENAMEL ESTIMATED LIFE LINE
AVERAGE LIFE, hours
TEMPERATURE, °C
○ Failure points determined by accelerated life testing motors.

Extrapolating from the data plotted above, we find that the life expectancy at 180 C of magnet wire insulated with this new enamel is in the range of 50,000 hours compared with 200 hours for wire insulated with the best organic enamels. *No. 4*

**SILASTIC** *continued*

less than 15 points. It shows no shrinkage and swell is less than 20 percent.

After 168 hours immersion in water at 158 F, swell is less than 10 percent and decrease in hardness is less than 10 points. It does not become brittle on continuous exposure at —65 F.

Silastic 80 offers another advantage in that it can be blended with Silastic 50 to fabricate parts having any Shore hardness between 50 and 80. These stocks can be blended to fabricate parts that meet SAE-ASTM Specification TA604. Heat-stable pigments can be used to give these stocks almost any desired color.

In electrical applications such as wire covering and cable coating, Silastic 80 retains excellent dielectric properties over a wide range of temperatures and frequencies. Cable insulated with Silastic 80 has a dielectric strength of 450 volts/mil at 50 C; 430 volts/mil at 250 C. *No. 3*

**PAINTS** *continued*

hours of such service. That introduced a costly hazard because any bit of rust or paint chips in a tray could cause rejection of a whole rack of carefully prepared antibiotics.

Some time ago, the racks were sand blasted, sprayed with a silicone-based aluminum paint. So far, the silicone finished racks have endured 150 hours at sterilizing temperatures with no sign of deterioration. As a result of that experience, Lederle is now using silicone-based paint to refinish sterilizing equipment throughout their plant.

At temperatures in the range of 500 to 1000 F. silicone-based aluminum finishes are used to protect stacks, exhaust mufflers, dryers, and furnaces. Modified silicone enamels in a wide variety of colors are used to protect appliances such as stoves, space heaters and incinerators at temperatures in the range of 400 to 700 F. *No. 2*

*First in Silicones*

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LARGEST PRODUCER OF: *SILICONE* Fluids • Abhesives • Adhesives • Release Agents • Compounds Greases • Water Repellents • Bonding Resins • Electrical Insulating Resins Molding Compounds • Expansible Resins • Defoamers • Silastic

a collection of many interrelated parts working in a coordinated manner and subject to failure of one or more of those parts at various times during its life.

Thus this question: Why can't insurance company procedures be adapted to predict the life expectancy of engines?

The answer is, of course, that AMC is doing just that. In the Research and Analysis division of the Directorate, actuarial methodology has been used to predict engine life. There is statistical proof that it works, in the available records of engines used in hundreds of cargo aircraft.

Requirements for production of one particular turbojet were reduced by 6,000 engines as a result of better understanding of the life expectancy. Furthermore, a planned production and overhaul facility was eliminated before it had been established. The savings on that one totaled high in the millions of dollars.

► **How to Compute**—First step in actuarial computations is to divide the maximum permissible engine operating life into arbitrary intervals—10 hr. for jet engines, 20 hr. for piston engines—out to the 600-hr. life of the jet and the 1,000-hr. life of the piston engine. These divisions correspond to attained ages in years for humans.

The next step is to examine field reports on engine removals for overhaul and establish the engine "exposures" and "failure" rates. An exposure is defined as one engine flying for 10 hours; if 500 hr. has been logged on all engines in the 0 to 10-hr.-old group, this is equivalent to 50 engine exposures. Failure does not mean an inflight failure; it means that an engine has been removed for major overhaul for usage reasons.

Records of engine removals give the total engine "failures" for each age period; with those figures and the exposures, a crude engine failure rate is established. (This is called a "crude" rate because the sample available for computation is small.)

► **Curve Smoothing**—Crude failure rates are plotted against engine operating hours and the jagged curve that results is then smoothed out mathematically.

This smoothed curve is used, with the attrition rate, to figure engine inventory at the end of each particular age period.

Comparison of this derived method and the old "single factor method" for predicting engine failures shows the errors inherent in the older technique. It used to be that engines were assumed to fail at a constant percentage rate, regardless of age; in one specific example (a J47 turbojet model), the actual rate was well below the constant


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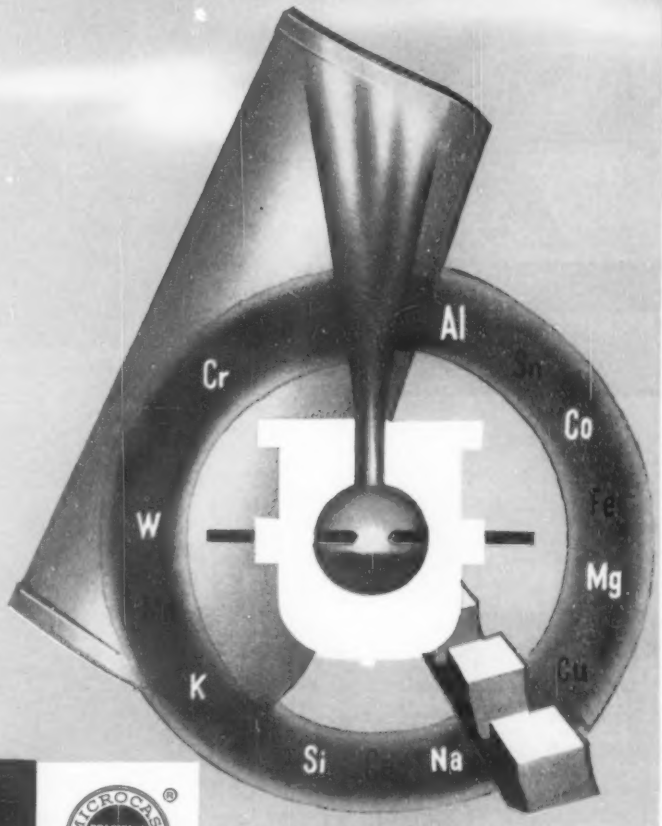


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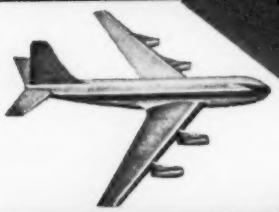

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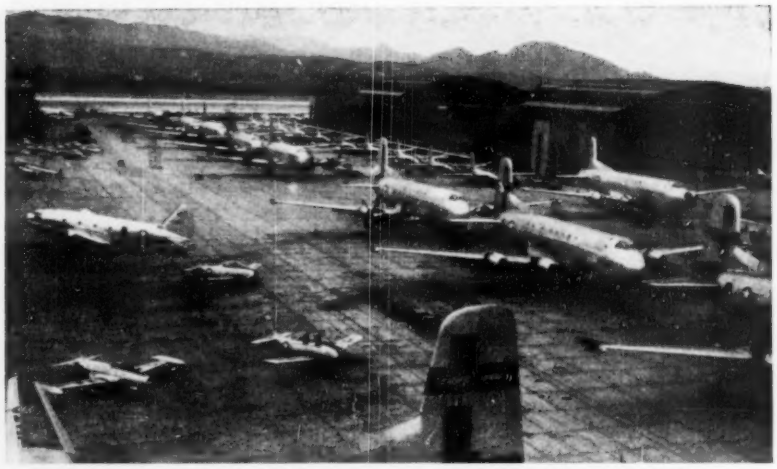

**OUTDOOR LINES** for C-124 and B-45 repair and modification at San Bernardino.

**WAITING THEIR TURN,** H-21 copters line up at Olmsted for overhaul.

rate during early life, but increased sharply after about 220 hr. of time.

By flying and failing a theoretical group of engines on paper, it is possible to determine the actual engine life expectancy. You can't predict failures this way; what you do get is a comparison of engine life, and long-range planning data.

There is one more trick left in the actuarial bag. Using the survival data developed earlier, plot a curve of the percent of engines surviving at any particular age against the age in hours. Then if you decide that you'd like to have X percent of the engines surviving at maximum life, pick off the maximum engine operating hours that correspond to that percentage survival. This makes it easy to establish maximum life requirements for engines.

▶ **Where It Applies**—General feeling in the Air Materiel Command is that actuarial methods can be used to predict life of engines and major accessories and equipment, but won't be used on units containing vacuum tubes or on airplanes.

Right now, tests are being run on B-36 propellers to get some start on actuarial data for accessories. Data gathering is one of the more important factors in this work, because actuarial methods can only apply where there is a large amount of basic data available.

By early September, reporting of failures from the field will be made by serial number to improve the data gathering.

San Antonio, Middletown and Oklahoma City are running their own actuarial studies as part of the decentralization of the Command.

## Project IRAN

IRAN—Inspect and Repair as Necessary—will save the United States Air Force an estimated $80 million this year in overhaul costs of its aircraft. Now completing its second year of operation as a maintenance and overhaul concept, IRAN is turning out such results as these:

- **Three Douglas C-47 airplanes** can be cycled through overhaul for the pre-IRAN cost of doing one airplane.
- **Two Douglas C-54 aircraft** can be overhauled for the price of one pre-IRAN job.
- **Contractor's B-29** overhaul costs

# Panagra Proves Airborne Radar With X-Band DC6B Installation

Last April, Panagra installed X-Band (3.2C.M.) in a regularly scheduled DC6B . . . flying between the United States and South America.

T. J. Kirkland, Panagra's Vice President of Operations, says, "Our radar equipped plane is able to avoid all significant storm areas. As a result it encounters no moderate or severe air turbulence. Our airborne radar, obtained from Bendix* Radio, has proved highly reliable in 'seeing' storms . . . day or night at ranges up to 150 miles."

**Flight Reports**

"On one occasion when lightning filled the sky and an electrical storm extended across the horizon on a flight between Panama and Guayaquil the plane flew through the area with hardly a bump and actually arrived at its destination ahead of schedule. Ordinarily these conditions would have resulted in significant deviations from course or a long period of slow flying which in both instances would have delayed the flight."

There was very little training required to familiarize flight crews with the equipment.

Panagra has specified installation of Bendix RDR-1 in the new DC-7's which it will receive next year. It's the first airline to order airborne radar as standard equipment.

For further information write Bendix Radio, Baltimore 4, Maryland.

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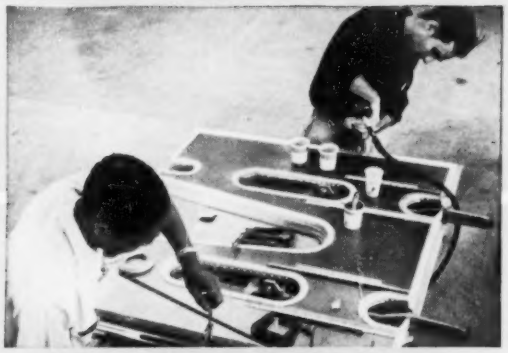
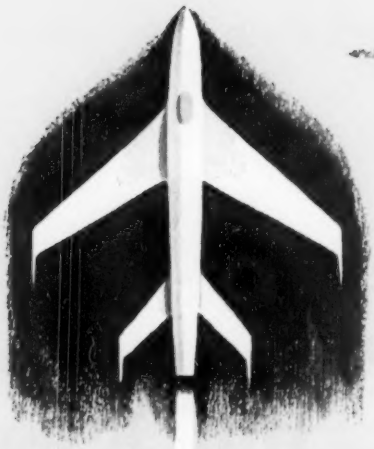
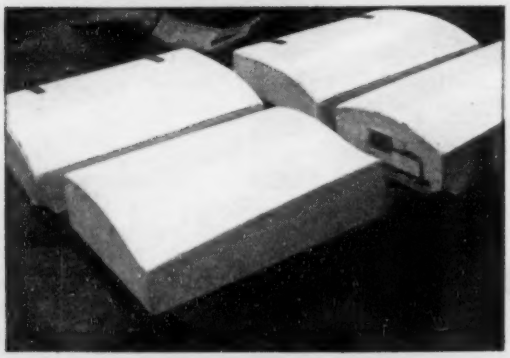


**Epon Solvent-Free Adhesives** permit instant assembly . . . often eliminate need for welding and riveting.



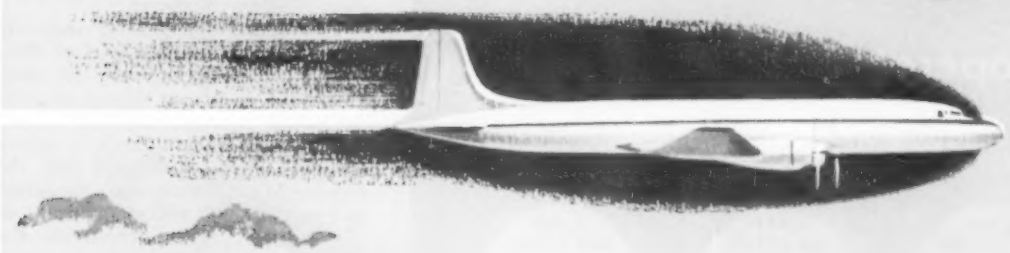
**Epon Coatings** resist attack of synthetic hydraulic fluids, gasoline, solvents, cleaning agents—reduce maintenance costs.

**Epon Structural** applications include air storage tanks for jet engine starter systems that are light, strong, and shatterproof.



**Epon Forming Dies** cut tool costs, speed production, permit rapid changes in design.

# RESINS are doing Aircraft Industry—



EPON RESINS, representing a new kind of plastic, have won immediate recognition in the aircraft industry because of their remarkable physical and chemical properties.

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Epon resins are ideal for printed circuit laminates, because of their high dielectric properties and dimensional stability. Due to their high strength-to-weight ratio, laminated sections made of Epon resin are light, durable and strong.

Your letterhead request will bring more information and samples of Epon resins.

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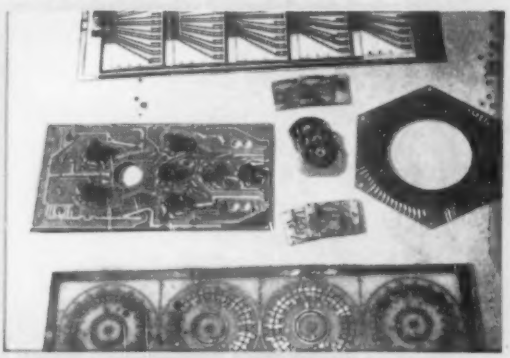

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Nearly 100,000 of these choppers now in service demonstrate the reliability and performance of this very popular model. Phase angle 65°, contacts SPDT, rated 2 ma, 100 volt max, dwell time about 135°.

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have been reduced from $151,800 to $77,450.

IRAN as a concept was developed by the Directorate of Maintenance Engineering and sold to the rest of the Air Force; work under the concept began in August 1952. It marks a common-sense approach to the maintenance of aircraft.

▶ **Scheduling**—Linked to the IRAN idea is another concept: time-phased scheduling of aircraft for overhaul. That phrase designates a systematic method of scheduling overhaul so that a constant percentage of planes is always being worked over.

This means a command keeps its strength up to a desired level of effectiveness while cycling one lot after another of its planes through maintenance and modification.

Key to the whole concept is inspection. The using command and the prime AMA, designated by regulation as responsible for the maintenance of the particular aircraft, coordinate the scheduling. Incoming planes are given a thorough shakedown inspection; preflight checks are made and functional tests are carried out. The aircraft, engine and equipment records are studied; the pilots' gripe lists, maintenance records and other documents are all part of the case history.

Out of this welter of data comes the work list of tasks to be accomplished. Then IRAN gets rolling.

▶ **It Used To Be**—Under the old system of maintenance, called DIR (and translated two ways: Disassembly, Inspect and Replace, or Depot Inspection and Repair), a plane in for overhaul was taken apart down to major subassemblies, and lots of time was spent in replacing things that didn't really need it.

Engines, props, wheels and tires, equipment, radio, instruments, and control surfaces came off and were replaced with rebuilt items. The airplane was prettied up, repainted inside and out, and came off the line like a new airplane.

But not so today. If the engines have useful life, they stay on. The cockpit is cleaned up, but there is no new paint put on the rudder pedals. The final result, of course, is an airplane that can perform its mission just as effectively as the brand-new one that came off the DIR line. The only difference is in the dollar cost of the overhaul.

There is never any compromise with the mission performance in IRAN; the ultimate job the airplane must do is the guiding factor throughout its overhaul.

▶ **Not So Easy**—This wasn't done without problems. There aren't any secondary quality standards for repair and

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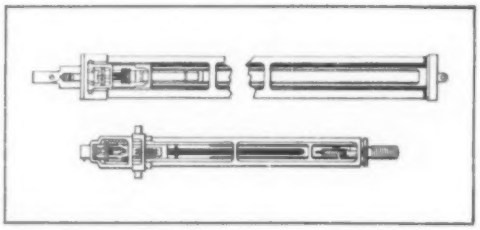

Top, M-3 Canopy Catapult. Bottom, M-5 Thruster for moving interior equipment away from personnel to facilitate safe escape.

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overhaul, for example. It is easy enough to define and control quality in new parts, but how can it be done for rebuilt ones?

There is also a lack of time-history data on accessories. Too often, these have been pulled and returned for rebuilding at arbitrary intervals. Project Bench Check, a sort of scaled-down IRAN for such equipment items as starters, generators and the like, has begun to pay off in dollars saved by applying the same philosophy of repairing when necessary.

IRAN personnel spent hours researching the records of the commercial airlines for their data on removals, inspections and repairs. Based upon the results of these studies, new standards for removal times have been established for these items.

In contract maintenance, the IRAN concept is turning out three C-47s for the price of one; two C-54s for the price of one. Accessories are being reused through bench-check techniques, saving about $70 million in calendar year 1953.

There have been two C-47 and three C-54 contract maintenance firms working on the new concept since January 1953.

And next? The Air Force says that IRAN will be applied to all aircraft as quickly as possible. Already B-47, F-86 and C-124 lines are being fed with IRAN thinking and techniques, and within a short time, the IRAN concept will be standard for the Air Force.

## Other Projects

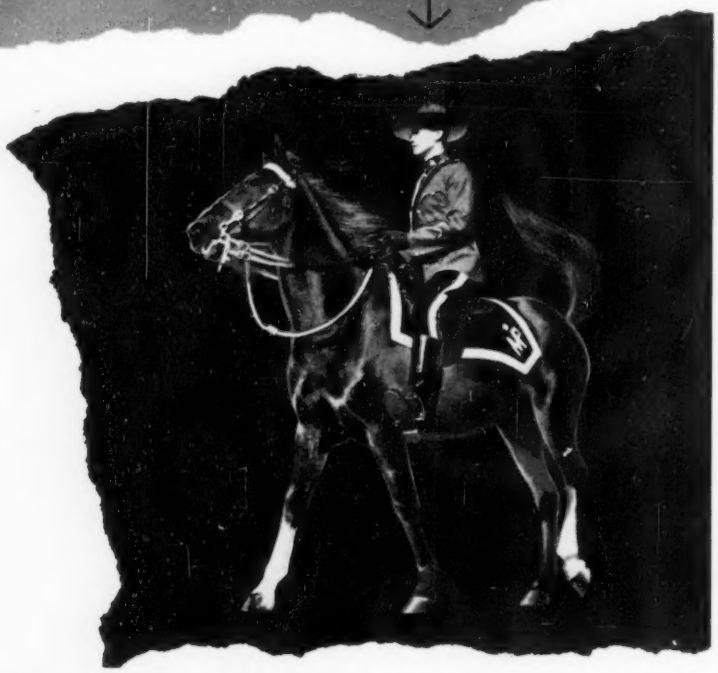
More than half of AMC's overhaul maintenance dollars was spent for contract maintenance during fiscal year 1954. This work was specialized, farmed out to private firms for reasons of economy and to keep the AMAs working on the most vital workloads.

▶ **Base for Expansion**—Current AF policy is to keep its own depots and AMAs manned on an efficient basis to handle the workloads judged most vital for carrying out the mission of the Air Force.

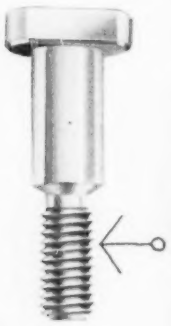
The kind of workload that generally is farmed out to private contractors might be typified by any one of the following examples:

- **Overflow workload,** where AMAs are already loaded with pre-scheduled work for an indefinite period.
- **Selected aircraft workload,** where commercial facilities are available or a special type of airplane might require the specialized knowledge available at a contractor's plant.
- **Commercial items,** such as typewriters and vehicles, where the local commercial outlet is already set up

RESPECTED



ON BOTH SIDES OF THE BORDER



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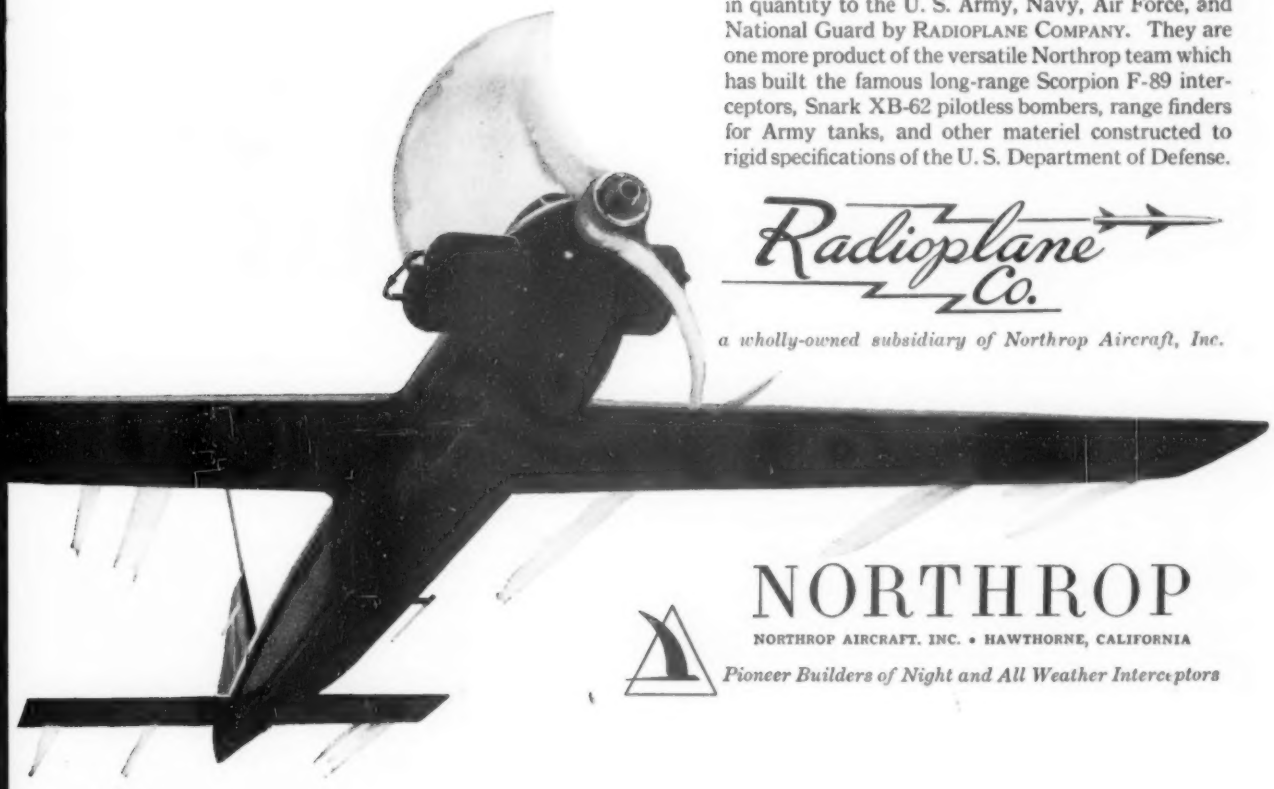

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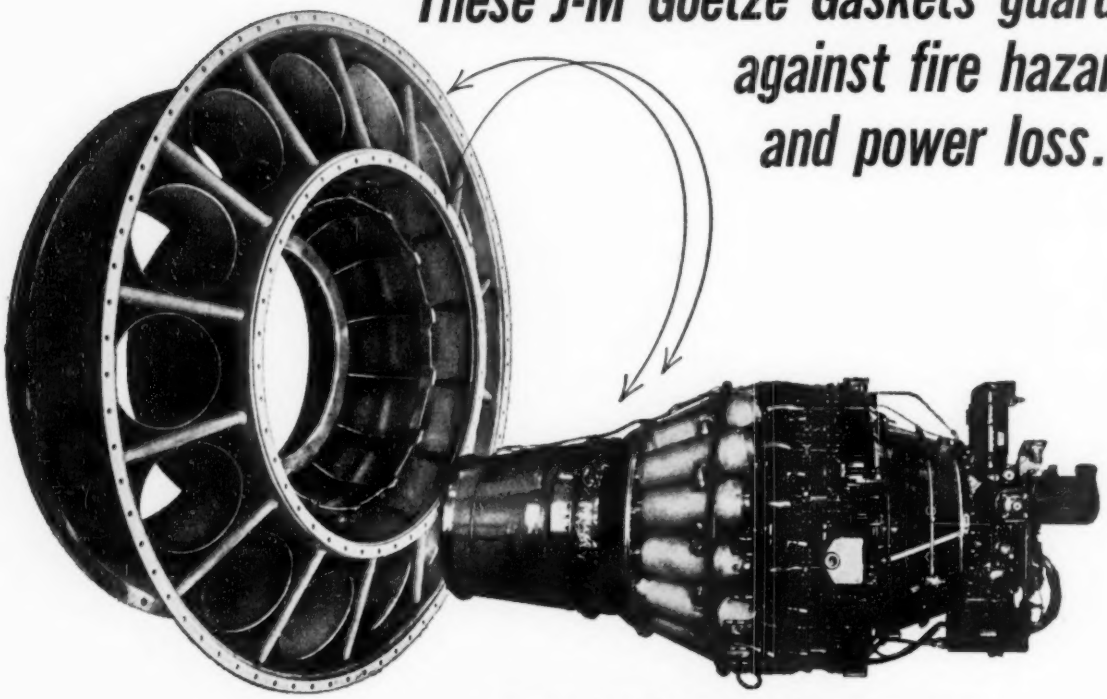

**Arrows point to J-M Goetze metallic gaskets** on the inner and outer annulus, and their approximate location on the J33 turbojet engine turbine frame.

## ...on powerful turbojet engines like the J33

Sealing the inner and outer annulus on the J33 to prevent leakage of fuel and flame into the airframe is another example of the many tough, critical sealing jobs entrusted to Goetze custom-crafted metallic gaskets.

For this particular service condition, the Goetze gasket specified is made from a flat gasket design... with the metal on both edges rolled around an asbestos filler. This construction provides the resilience needed to overcome the warpage encountered in these applications. Like all Goetze gaskets, this style is precision-made to fit tight and stay tight in service.

There is a Johns-Manville Goetze gasket for practically every jet aircraft requirement. Goetze craftsmen can fabricate them in almost any shape or size for sealing igniters, compressor bleed-offs, cross ignition tubes, combustion chambers, fuel nozzles, turbine drain lines, etc. Backed by more than 60 years of Goetze "know-how," these durable gaskets are solving many of industry's most complex sealing problems.

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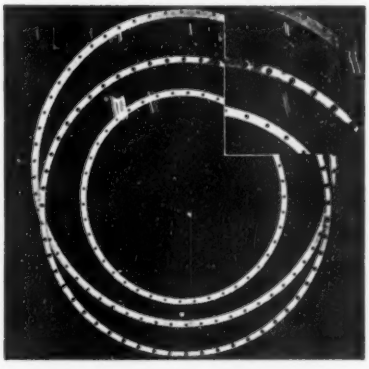

**Close-up of J-M Goetze metallic gaskets** used as inner and outer annulus gaskets on jet engine turbine frame.

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with tools and equipment to handle the job.

• **Analytical overhaul** by the prime contractor.

This last point is worth elaborating. It means that a prime contractor, manufacturer of an engine or an airplane, will perform the first overhauls on his own product. Air Force says there are many advantages here. Overhaul procedures and the equipment will be improved as a direct result of the manufacturer's problems. Modifications can be more quickly accomplished because of the instant availability of special tools and contractor-furnished parts.

The prime contract manufacturer should be in a better position to forecast his spare parts requirements, and to develop and refine tools for overhaul.

▶ **Jet Repair**—Some time ago, it was discovered that the jet engine was basically a simpler engine to maintain in the field. Korea provided the acid test of those ideas; minor overhaul at base level was the procedure then.

By now, ideas have jelled into policy, and the Air Force does its jet engine minor repair work in the field at the base level.

Air Force says this program has been extremely effective in increasing the life of jet engines; as an average figure, AF officials say that engine life has been doubled.

Some data on the General Electric J47, for example, showed that at one time, engines were averaging about 130 hr. before being removed for overhaul. When the minor repair was done at the bases, this figure jumped to about 220 hr. before overhaul.

▶ **Technical Orders**—Bane of a crew chief's life, the Tech Order, and the system which spawns them are in for considerable revision.

Present distribution of Tech Orders is a stack 79 mi. high, or about 2.2 billion pages. Each USAF base has been required to keep a complete file, a procedure which gave SAC wings complete sets of TOs on their basic trainers.

Three approaches have been used to simplify the current system. First, the numbering scheme has been revised. A B-47 TO, to cite one case, would have been numbered like this: O1-20-E-N-B-76, a long and illogical designation. Under the new system, this becomes 1-B-47-B-76, which means that it is the 76th TO for the B-47B aircraft.

Second, the books are being rewritten along the systems concept. Instead of a book on the aircraft electrical system, there are now books on the specific electrical systems; if the


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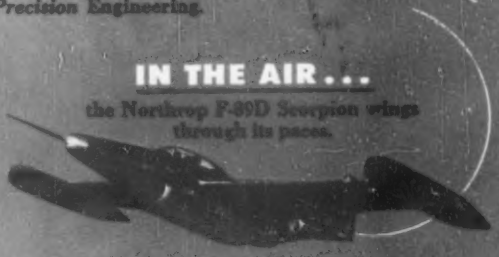
Capable of duplicating exactly the in-flight characteristics of the Air Force's new all-weather interceptor – the twin-jet Northrop Scorpion – the F-89D Simulator represents another milestone in the twenty-five year history of Link *Precision* Engineering.

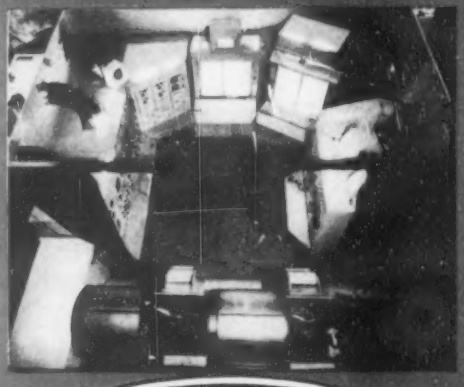
IN THE AIR . . .

the Northrop F-89D Scorpion wings through its paces.



ON THE GROUND . . .

Link's training version of the F-89D with tandem cockpits in the foreground and flight and radar instructors' area in the rear.



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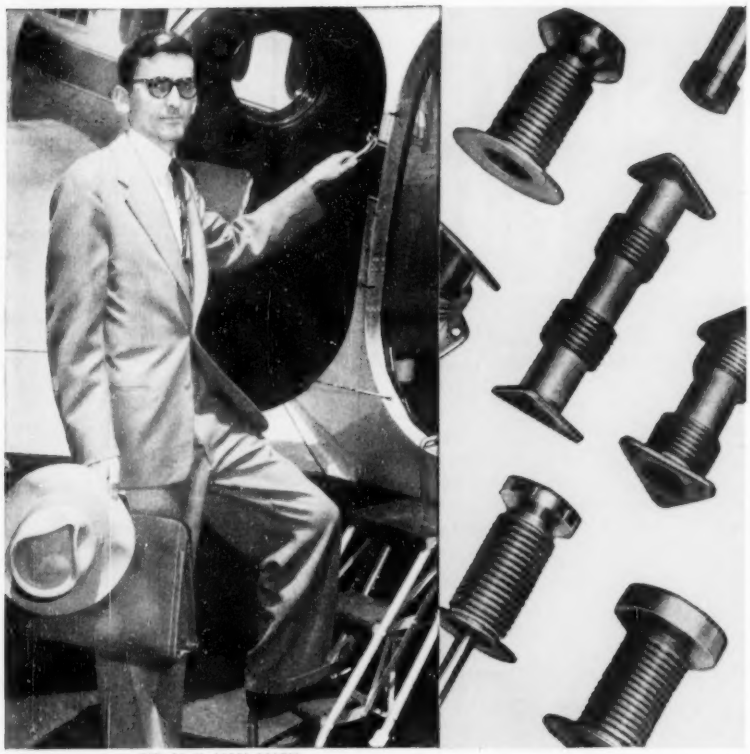
**LINK invites employment applications from engineers and draftsmen.**

# Call this bellows engineer



MR. V. K. VAN ALLEN
*of our staff of bellows application engineers*

## for help on design problems involving bellows assemblies for aircraft

● He can help you—show you how a bellows assembly can do the job. What's more, he'll know the kind of bellows metal needed—brass, stainless steel, monel, nickel, etc. He'll specify the right bellows charge—volatile liquid or gas. He'll help determine the type of ends needed, the minimum life required and other vital factors. You'll be assured of a bellows assembly exactly suited to your requirements, to make your products perform better.

There are many uses for Bridgeport and Sylphon bellows assemblies—for thermostatic devices, pressure controls, expansion joints, hydraulic mechanisms, as flexible connectors and more applications.

Our bellows application engineers will gladly work with you. Our half-century of experience and ample production facilities assure you quality workmanship, on-time delivery.

**SEND FOR FREE BULLETIN**

Write today for Bulletin that tells you all about metal bellows and bellows assemblies—gives you ideas! Ask for Catalog QA-1400.

Robertshaw-Fulton
CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION
BRIDGEPORT 1, CONNECTICUT

FULTON SYLPHON DIVISION
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mechanic is working on radio, he doesn't have to page through instruction on the cabin lighting to find the chart he needs.

Third, the distribution system is being revised. Bases will only get the TOs that pertain to the aircraft they operate. Books will become the property of the crew chief, to have with him, instead of making him trek to the library to get the books he needs for each job.

Distribution of TOs will be the responsibility of the manufacturer and the prime AMAs.

▶ **Sight Line**—The Directorate of Maintenance Engineering has a job of customer service to do. One such recent example was Project Sight Line, the technical support of fire control systems used in the Far East theatre.

Specially qualified technical personnel were sent to Korea for temporary duty of about three months in early 1953.

Their mission: to improve the maintenance and logistic support of the A-4 gunsight equipment and to modify the APG-30 radar and the MA-3 fire control systems in F-84s and F-86s. In addition, they had to establish a depot in the theatre for overhaul of A-4 gunsight components.

Spares and more than 50 tons of test equipment accompanied the project teams. The depot was established and training courses started in the use of the depot overhaul equipment.

Test personnel delivered critical items of test equipment to each USAF fighter organization in Korea and Japan. They lectured pilots and maintenance personnel in the care and use of MA-3 fire control systems.

A special armament system trailer was designed and furnished to act as a complete armament shop, and served that purpose for fighter organizations until they could set up their own permanent shops.

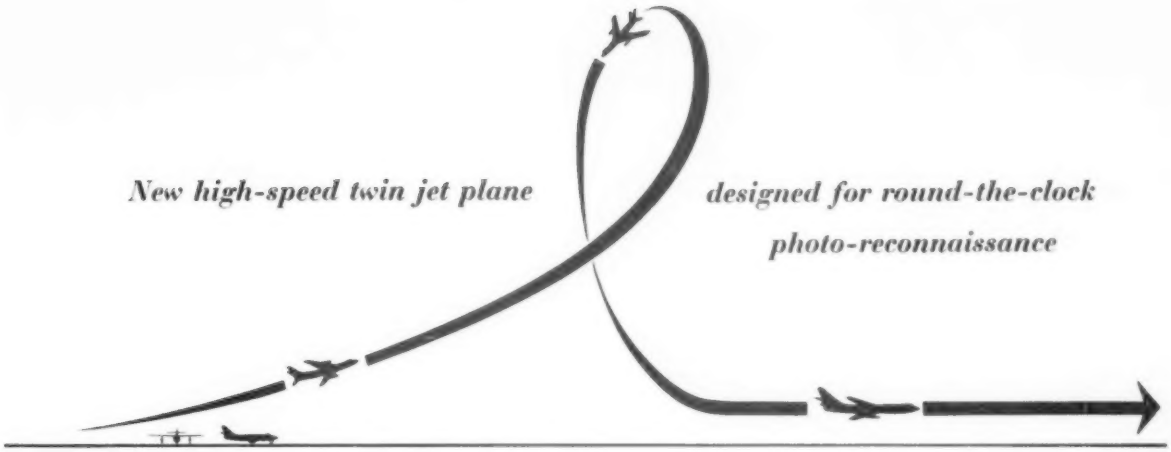
The project was completed at the end of June 1953. It would be hard to estimate the savings in terms of dollars, says the Air Force, but it must have been a considerable amount.

▶ **Epilogue**—These are some of the jobs and techniques that are the daily concern of the thousands of persons in the Directorate of Maintenance Engineering.

The jobs they do are sometimes routine, sometimes decidely unglamorous, but always important. The skill of the riveter backs up the skill of the pilot; the planning of the production controller ties in with the strategic planning of Headquarters USAF.

Other people build the airplane, others transport them, still others fly them. But maintenance engineering keeps them flying ■ ■ ■

*New high-speed twin jet plane* *designed for round-the-clock photo-reconnaissance*



## —the Douglas RB-66

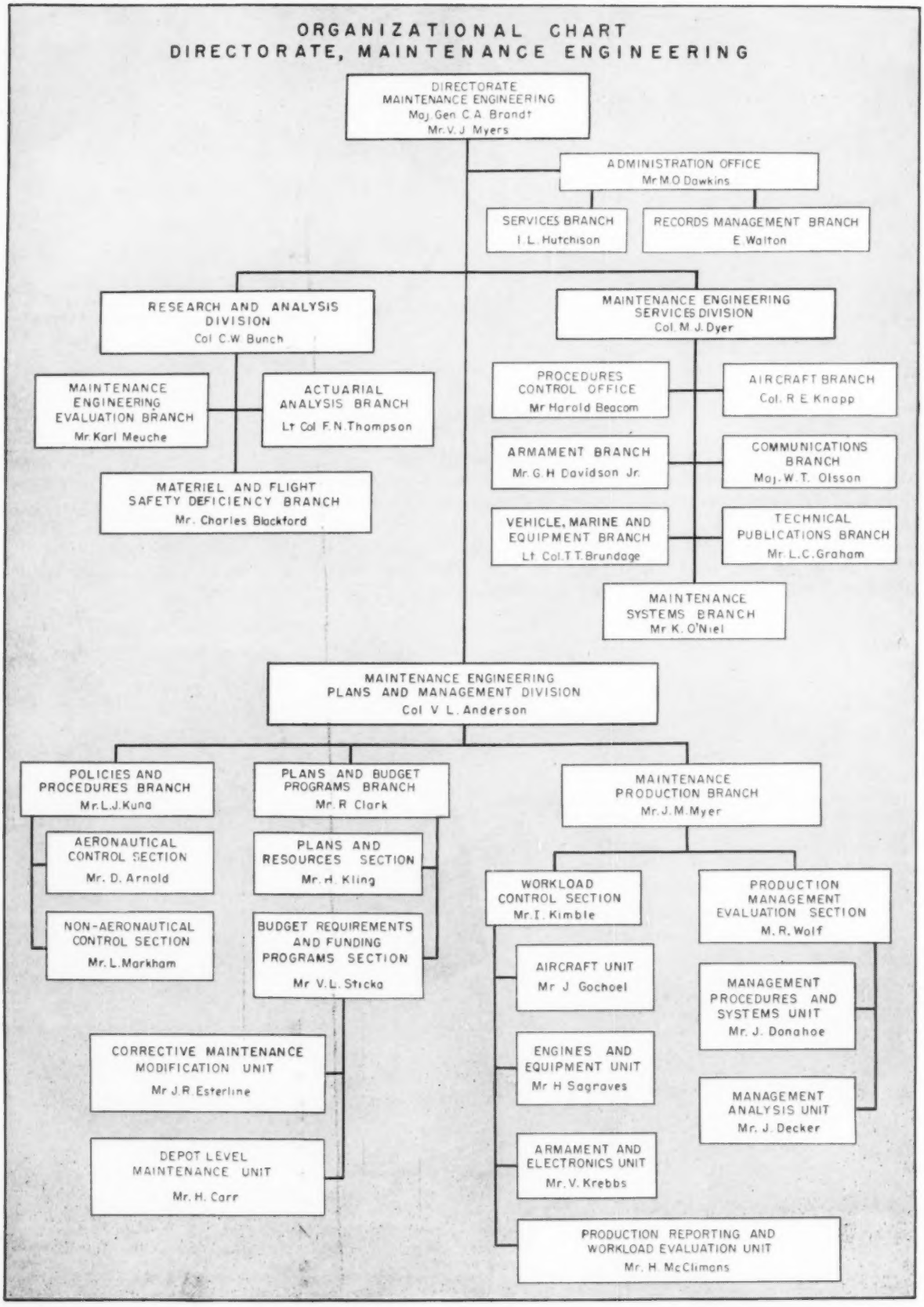
Now in production for the U. S. Air Force, the Douglas RB-66 will be one of the most versatile photo-reconnaissance planes ever designed.

Complete performance data is still restricted, but this much can now be told. Powered by twin jets, slung in pods from its sharply swept wings, RB-66 will fly in the 600- to 700-mile-per-hour class. Range will permit deep penetration for all-weather, around-the-clock photo-reconnaissance or mapping. Photographic equipment will be of the most modern to collect detailed information by day or night.

Development of RB-66 is another example of Douglas leadership in aviation. Planes that can be produced in volume to fly *faster and farther with a bigger payload* are a basic rule of Douglas design.

*Enlist to fly in the U. S. Air Force*

**Depend on *DOUGLAS*** **First in Aviation**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# new ARC course indicator gives you

# two instruments in one!

ARC #16706

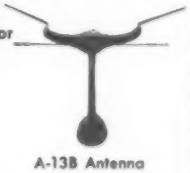
## TYPE 15D EQUIPMENT

***Compact... Lightweight... CAA Certificated***

For Airborne Reception of Omni-Directional Ranges • Visual-Aural Ranges • Runway Localizers Simultaneous Voice • GCA Voice

Course Selector and Cross-Pointer Meter in a single unit

R-13B Receiver with D-10A Dynamotor B-13 Converter, E-14 Rack and M-10 Mounting



A-13B Antenna

C-22A Control Unit, M-18 Mounting

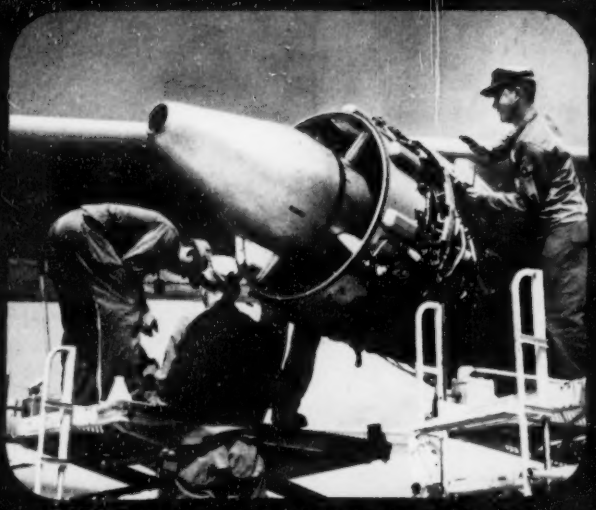
Now users of the light, compact ARC Type 15D navigational receiving equipment can employ a single panel instrument that performs the work of two units previously used. The cross-pointer meter and the course selector have been combined into one part that fits a standard 3⅛" instrument hole.

This saving in instrument panel space is important, particularly now that dual VOR installations are so popular. In addition to the space saving, installation costs are cut.

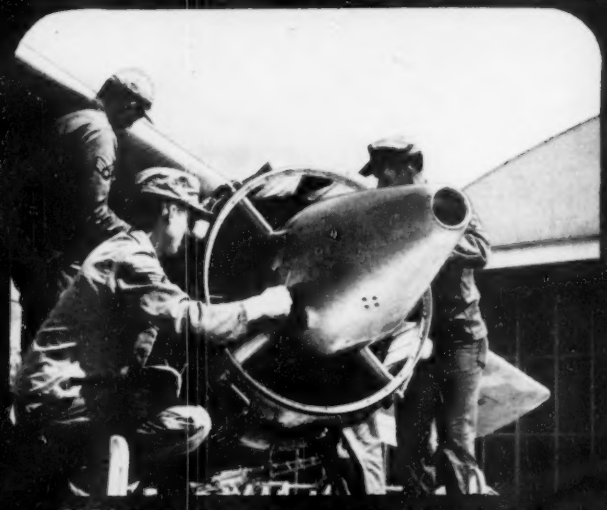
Ask your dealer to specify the new #16706 Course Indicator as part of your 15D installation – whether single or dual. The indicator may be purchased separately for use with older Type C and D equipment. Write for complete data.

**Aircraft Radio Corporation**

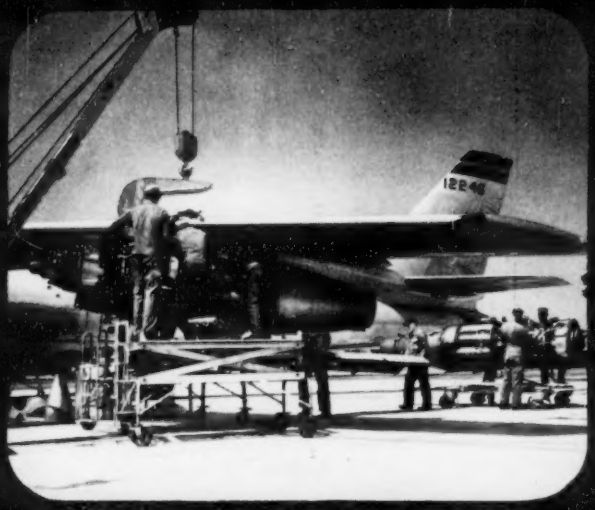
BOONTON • NEW JERSEY



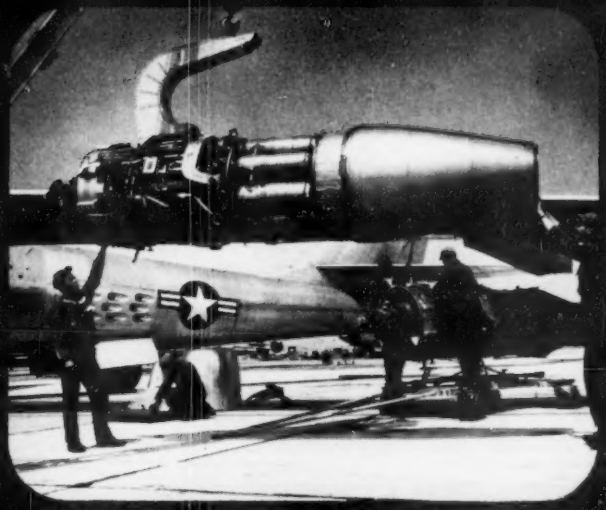
**0900** Stepping up on their work stands, line crew removes outboard engine cowlings.



**0906** Quick-disconnects of J47 electrical, fuel, and oil lines are completed.



**0911** Crane car lifts engine forward as replacement unit rolls into background.



**0914** Engine is swung away from wing as new J47 is pulled into position.

**0919** New engine hoisted up while crew installs J47 fuel, oil, and electrical lines.

**0924** Aluminum "bullet nose" and cowlings are clamped on just before running engine up.

G-E ENGINES POWER S.A.C. OPERATIONAL MULTI-JET BOMBERS

# Simple design of G-E J47 helps S.A.C. crew make

# 25 MINUTE ENGINE CHANGE!

**MacDill AFB photos show how G-E engines, Boeing wing pods, and S.A.C. ground crews have cut bomber maintenance time and costs**

A Strategic Air Command B-47 ground crew recently changed a G-E J47 jet engine in 25 minutes. We mention this for two reasons: twenty-five minutes is about *one-eighth* the time it used to take to change a WW II bomber engine. And the 25-minute change is typical of the ways in which the J47's clean design and durability help S.A.C. save time and money.

### Good design: Easy maintenance

The J47's relatively simple construction makes the engine very easy to maintain, compared to other types of powerplants. For example at MacDill AFB, S.A.C. crews get up to 600 hours from J47's before minor repair. This is nearly twice the minor repair average of S.A.C. piston engines. And naturally the cost of J47 maintenance—and the human effort involved—is less.

### Good design: Long operating life

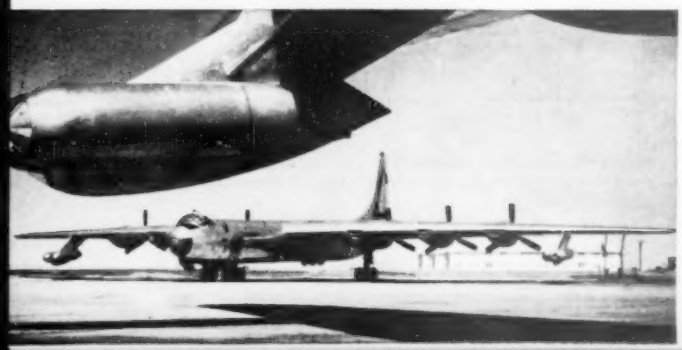
Proof of the J47's durability lies in the fact that B-47's attached to the 306th Bombardment Wing have gone more than 600 hours *without a single engine change.* That's the equivalent of 15 nonstop globe encircling flights. A Tampa newspaper has quoted a B-47 ground crew as calling their J47's, "The engines that never quit."

Facts like these illustrate the J47's contribution to the Strategic Air Command. *Section 232-2, General Electric Company, Schenectady 5, N. Y.*

*Progress Is Our Most Important Product*

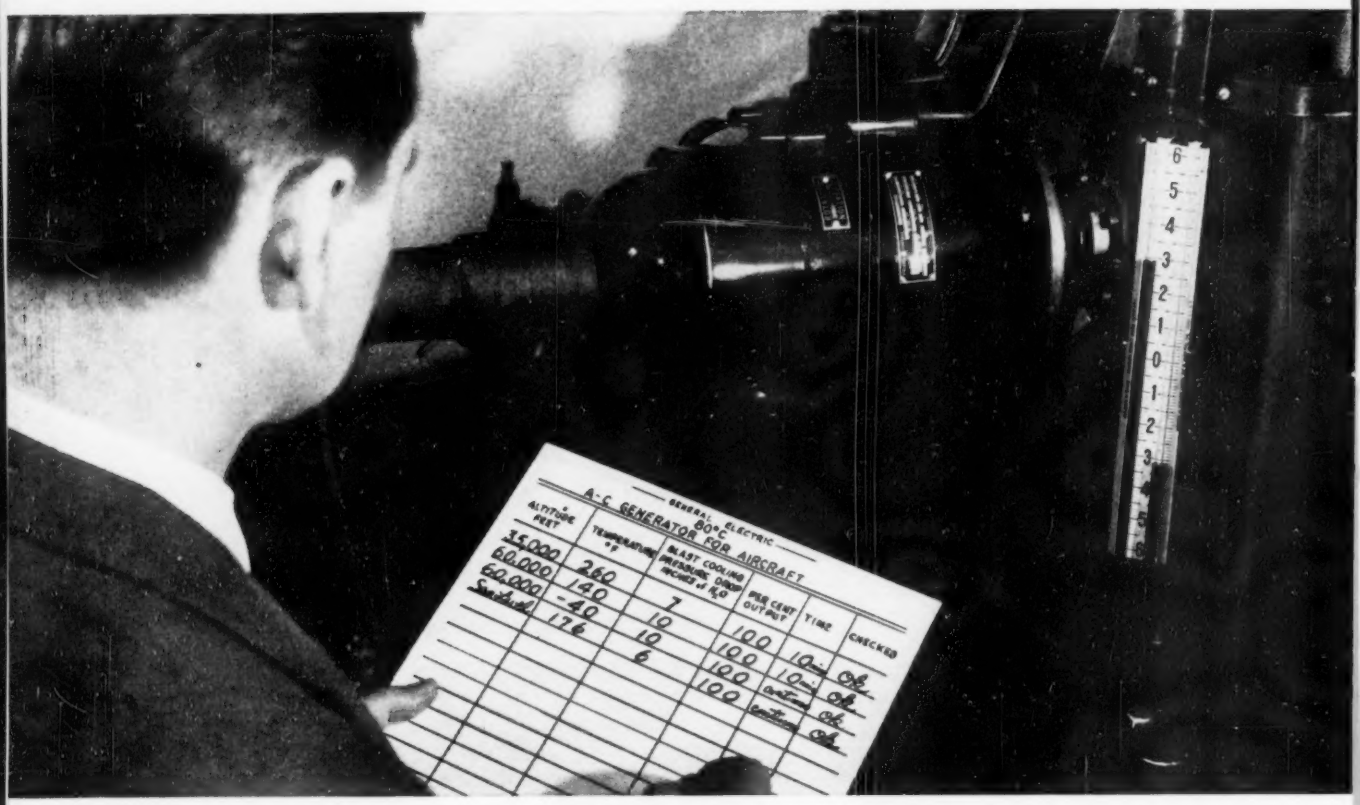
GENERAL ELECTRIC

**EASE OF J47 MAINTENANCE** is illustrated by this photo of a S.A.C. B-36 outboard wing pod. J47 installation can be removed quickly for minor repair and overhaul.



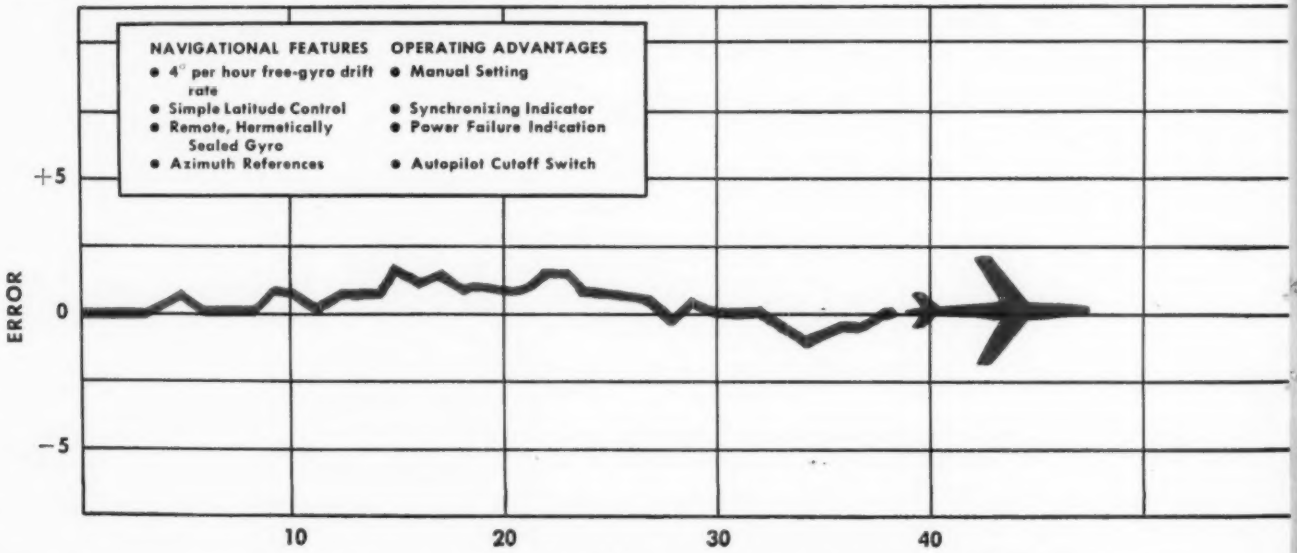
**LONG J47 OPERATING TIME BETWEEN OVERHAULS** is typified by B-47 No. 12234 of S.A.C. 306th Bombardment Wing. Aircraft flew more than 600 hours without a single engine change.

# New G-E automatic a-c electrical system




New G-E high-efficiency a-c generator has no harmonic over 1%, and offers full load recovery in about 1/10 sec. Available ratings: 10 to 60 kva, 380/420 cycles, 5700/6400 rpm, 120/208 volts.

# New G-E compass system reduces aircraft




Low drift of gyro system proved in laboratory and flight tests. The above drift curve was obtained during a roll-pitch-yaw test on a G-E gyro unit. This test, conducted by an outside equipment laboratory, showed that at no time did the drift rate exceed 4° per hour—66–80% reduction over previous systems. Flight test conducted later upheld the laboratory findings.

# delivers load at 260F

A new, fully automatic parallel a-c electrical system which eliminates normal manual switching, and delivers rated load at higher ambient temperatures than ever before possible, has been developed for jet aircraft by General Electric.

### Designed for supersonic dash

Designed specifically to meet the high ram-air temperatures of supersonic dash, this new G-E generator system provides the best voltage regulation and most advanced system protection available in production today. The automatic system delivers full load at:

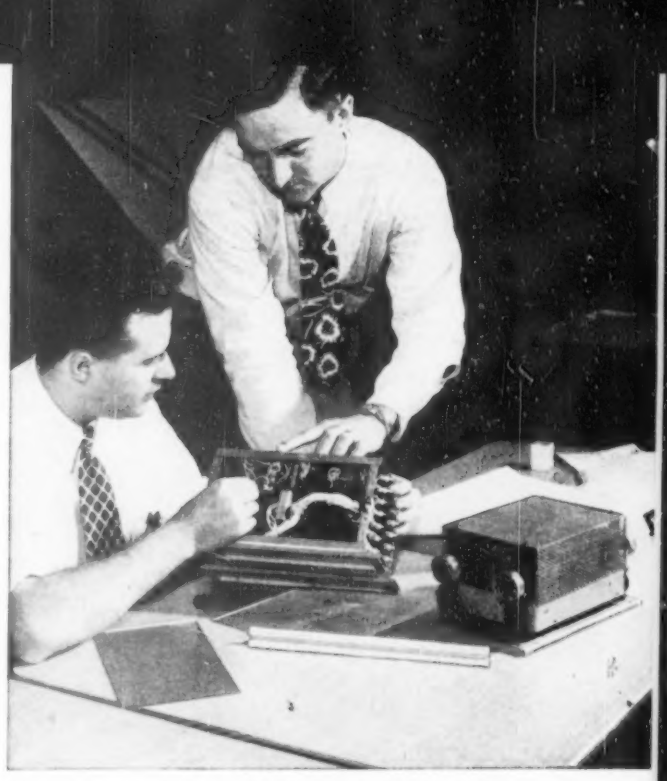
- Sea level with 176 F cooling air at 6-inch water drop (continuous).
- 60,000 feet with −40 F cooling air at 10-inch water drop (continuous).
- 60,000 feet with 140 F cooling air at 10-inch water drop (ten minutes).
- 35,000 feet with 260 F cooling air at 7-inch water drop (ten minutes).

### Speeds take-off, spares pilot

The first completely automatic a-c system ever produced, the new G-E equipment begins operating as soon as the pilot starts an engine. The system contains only two toggle switches, which can remain "on" at all times unless a fault develops. This eliminates a series of pilot functions, and sharply reduces time required to become airborne after the pilot climbs into the cockpit. System control and protection is fully automatic.

### Single source for complete systems

General Electric offers a single source for complete a-c or d-c power generation systems for any aircraft. For more information, contact your nearest G-E aviation specialist, or write Section 210-86, General Electric Company, Schenectady 5, N. Y.



**Major components of the new G-E system in addition to the generator are:**

1. **New static regulator (left)—designed to last the life of the aircraft though regulator is only 390 cubic inches and weighs only 13 lbs.**
2. **Control and protective equipment (right) automatically locates and isolates any faulty generator. Control panel weighs only 8½ lbs. for a single-generator system and only 10¼ lbs. for parallel generator systems.**

# drift rate 66 — 80%

A new compass-controlled directional gyro system which offers a free-gyro drift rate of only 4° per hour—66 to 80 per cent more efficient than present systems—has been developed by General Electric for helicopters and fighter aircraft.

### Weighs only 17.5 lbs.

Compact and lightweight (approximately 17.5 lbs.), the MA-1 compass system is designed to meet the requirements of any synchronous course-indicator, and will operate from all compass transmitters built to Air Force specification AF-27635.

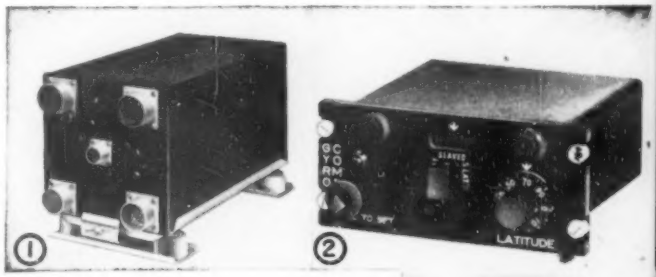
### Accurate, stabilized heading information

The MA-1 system offers accurate, stabilized heading information continuously through 360° in azimuth when slaved to the earth's magnetic field through a modern remotely mounted compass.

Featuring a normal slaving rate of approximately 2° per minute during compass-controlled operation, the MA-1 system also provides for controlled latitude-drift compensation.

### Aircraft systems development

For additional information regarding reliable aircraft systems development, contact your G-E aviation specialist or write Section 210-86A, General Electric Co., Schenectady 5, N. Y.




1. **Amplifier provides a junction box for various components and power source as well as containing leveling, slaving and servo amplifiers, servo unit with detector, follow-up and output synchros.**
2. **Controller is used in conjunction with the radio-magnetic indicator for setting directional heading and latitude control and for general operation of the system.**
3. **Directional gyro, heart of the G-E system, is a remote, low-drift hermetically sealed gyro used to obtain a stabilized azimuth heading.**

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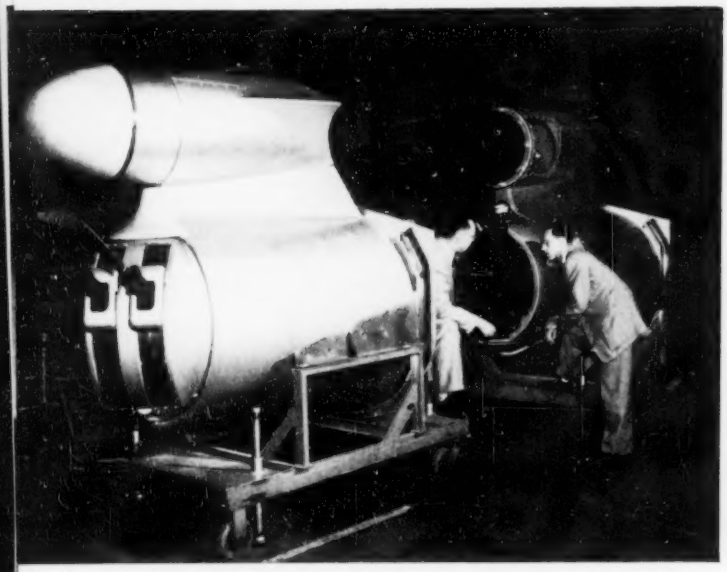
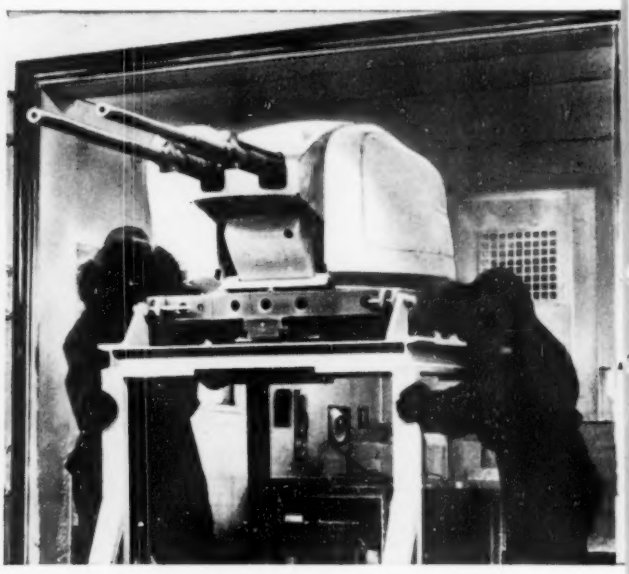
# New G-E armament system gives jet bombers

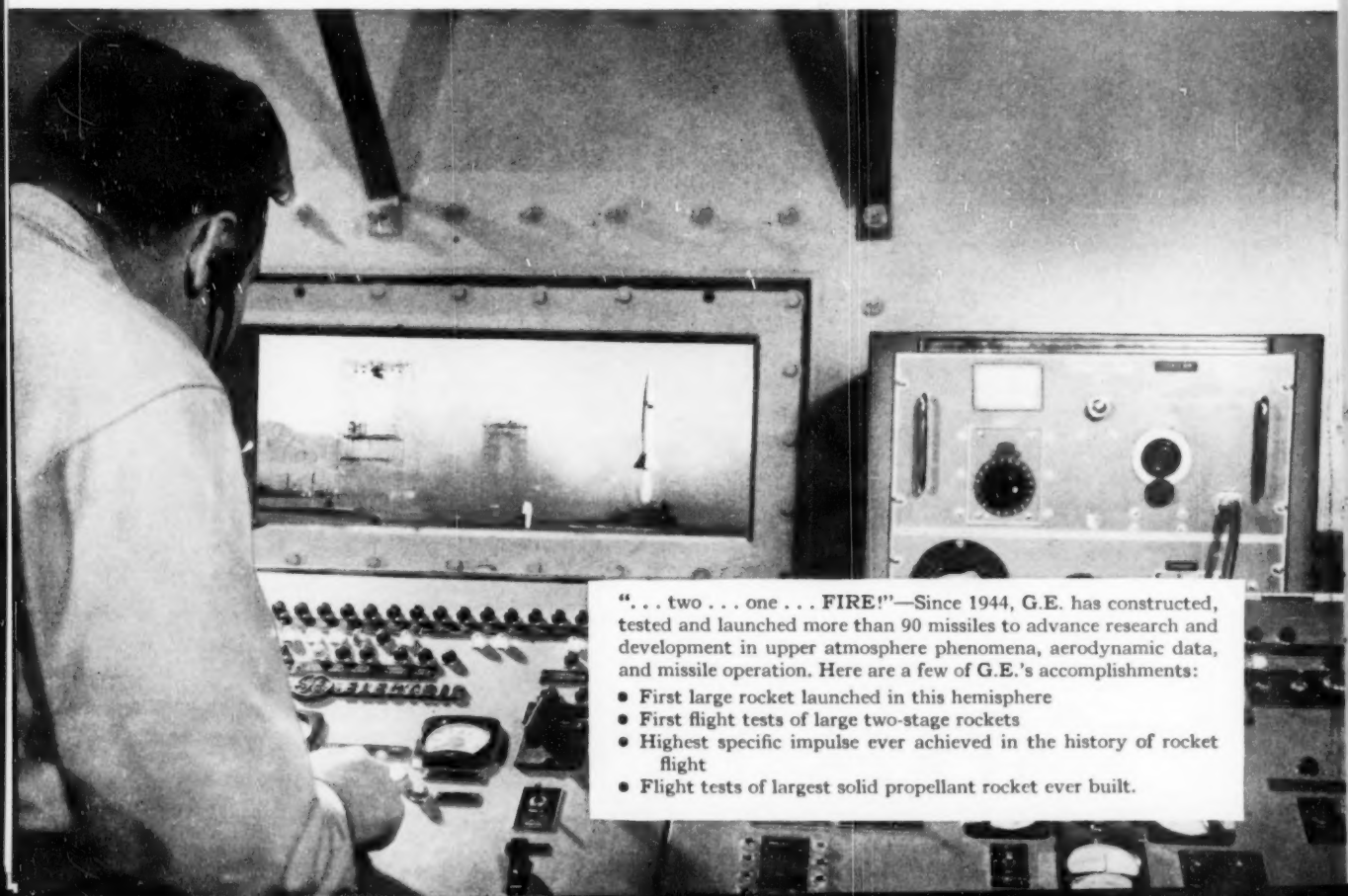


This new 20 mm system is a result of G.E.'s "integrated system" approach whereby a group of engineers is responsible both for development and modification of a system for greatest efficiency and ease of maintenance.



Cold and hot chambers with temperatures ranging from −90 F to 170 F are only two of the elaborate tests G-E armaments systems undergo to help insure maximum flight efficiency.

# New land-sea-air uses for rocket propulsion



"... two ... one ... FIRE!"—Since 1944, G.E. has constructed, tested and launched more than 90 missiles to advance research and development in upper atmosphere phenomena, aerodynamic data, and missile operation. Here are a few of G.E.'s accomplishments:

- First large rocket launched in this hemisphere
- First flight tests of large two-stage rockets
- Highest specific impulse ever achieved in the history of rocket flight
- Flight tests of largest solid propellant rocket ever built.

# automatic defense

A remote-controlled 20 mm armament system, capable of finding, tracking and hitting hostile aircraft even in the night or fog, has been developed by General Electric for high-speed jet bombers.

### "Packaged" protection for B-47E and RB-47E

Under security wraps for three years, the G-E fire control system provides more reliable, automatic protection for the Boeing B-47E and RB-47E jet bombers. Compact, the 20 mm system is delivered packaged, tested, and ready to be installed as a complete tail section.

### Automatic warning, tracking, correcting

The system performs the following functions:

- Provides automatic radar warning of approaching aircraft
- Automatically tracks and positions guns on selected target
- Continuously corrects for windage, ballistics, and lead errors by means of an electric computing network
- Fires guns electrically when target is in range.

### System Engineering

Bomber survival is increased as a result of this integrated, effective, compact system. Competent system engineering is one reason why almost every U.S. operational heavy and medium bomber today is equipped with General Electric armament systems. General Electric Company, Schenectady 5, N. Y.

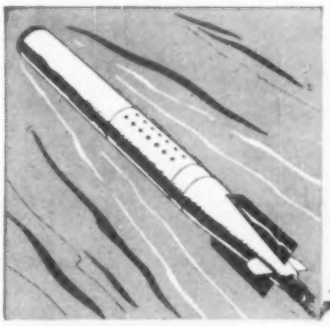
**Remote-controlled G-E armament system gives the Boeing B-47E and RB-47E jet bombers a heavyweight punch to the rear. Guided by radar, the 20 mm system can track and hit unseen targets.**

# under study by G.E.

Ten years ago, rocket propulsion had but one use . . . to launch missiles. But today, rocket power as a source of high pressure, high speed, high temperature gases and power can be used in such applications as torpedo propulsion, catapult energizers, high-speed flight, thrust augmentation, rocket booster and sustaining power, high-speed research sleds, glider take-off and landing, supersonic wind tunnels, mining, plus many additional latent military and industrial uses which will be brought out by research and development.

Experience, manpower and facilities make it possible for G.E. to design and develop rocket motors or rocket propulsion systems for use on land, sea or in the air.

The amazing growth of rocket propulsion offers a challenge to the ingenuity and imagination of American industry. This challenge—to apply the tremendous power of rocket propulsion to ever-newer applications—can be met only through continuous research and development. To this end, General Electric offers its successful experience, its trained manpower, and its extensive facilities. General Electric Company, Schenectady 5, N. Y. 210-86B



**TORPEDO PROPULSION**

**THRUST AUGMENTATION**

**MINING**

**SUPERSONIC WIND TUNNELS**

*Progress Is Our Most Important Product*

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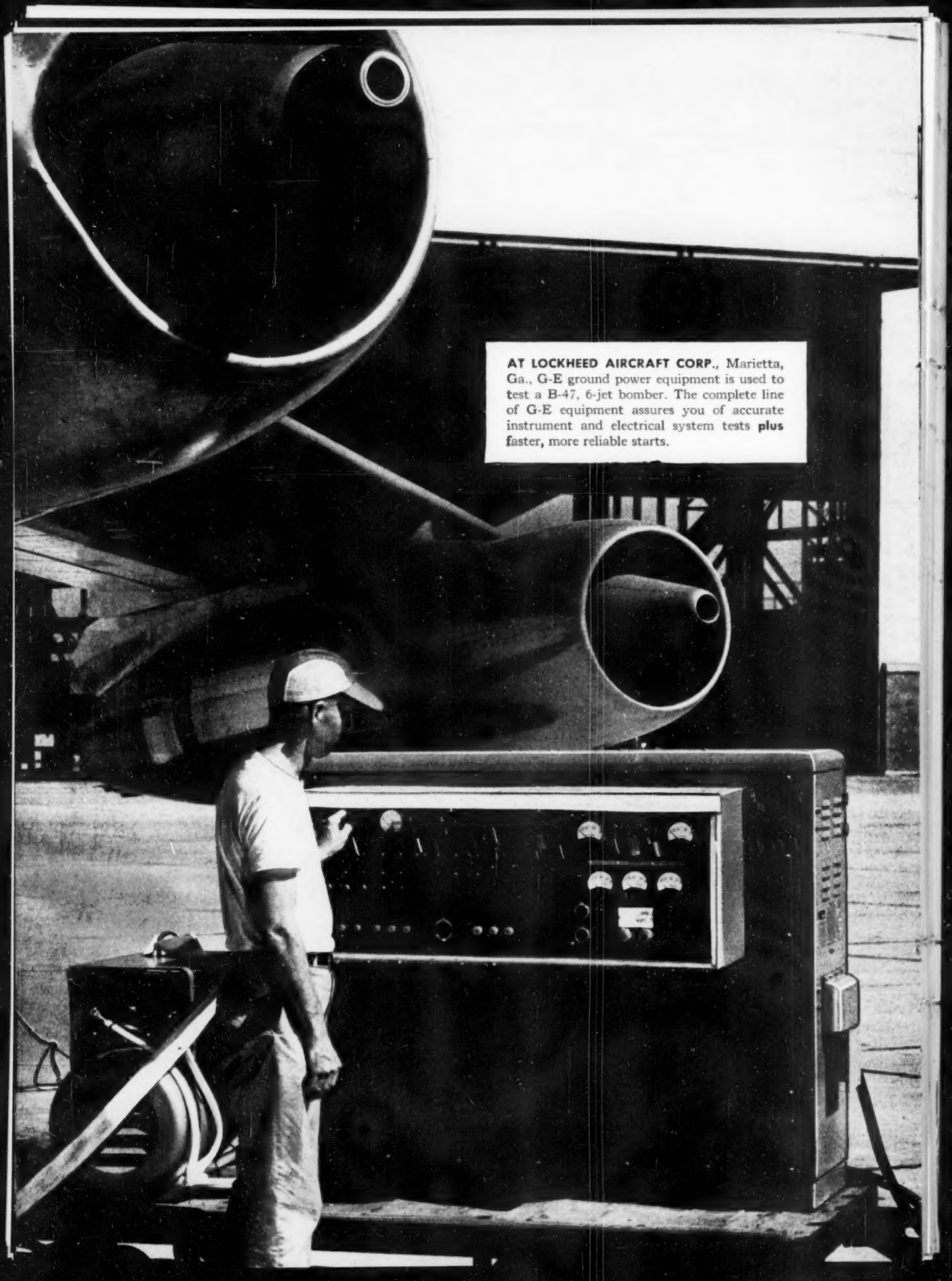


**AT LOCKHEED AIRCRAFT CORP.**, Marietta, Ga., G-E ground power equipment is used to test a B-47, 6-jet bomber. The complete line of G-E equipment assures you of accurate instrument and electrical system tests **plus** faster, more reliable starts.

*For all types of aircraft and guided missiles . . .*

# G-E Ground Power Equipment Gives You Accurate Testing, Servicing . . . Faster Starts

**General Electric's complete line of ground power equipment —field proved—assures you of the right auxiliary power for aircraft starting, servicing or testing requirements.**

**READILY ADAPTED** to stationary installations or mobile use, G-E ground power equipment provides:

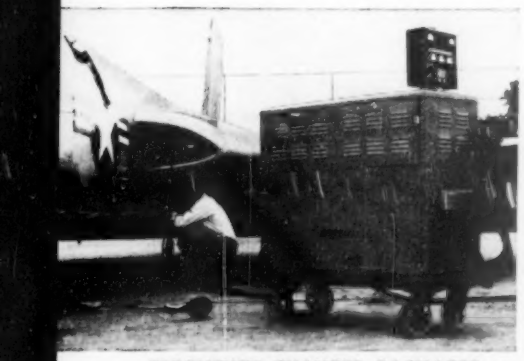
1. Fast, "every-time" starts for jet or reciprocating engines.
2. Ground checking and testing of instruments, devices and guided missiles on flight ramp or in pit installations.
3. Auxiliary power for shop and hangar repair areas.
4. Aircraft factory production testing for any type of aircraft electrical equipment.

**ACROSS THE COUNTRY,** aircraft manufacturers, airports, the armed forces and ground power equipment manufacturers have installed and applied these dependable, accurate G-E units and components for every auxiliary power use. General Electric has devoted extensive field studies to ground power requirements, and the engineering experience gained through the design of packaged power equipment over the years assures you of getting dependable, low-maintenance performance.

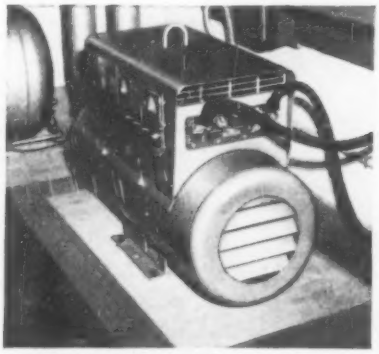
**WHATEVER YOUR NEEDS** in ground power, General Electric can engineer the right equipment to meet specific conditions of your operating needs and location.

Specify General Electric when you need more reliable and accurate ground power . . . G-E Aviation Specialists are always ready to assist you. For further information, contact your nearest G-E Apparatus Sales Office, or write General Electric Company, Section 821-2, Schenectady 5, N. Y.

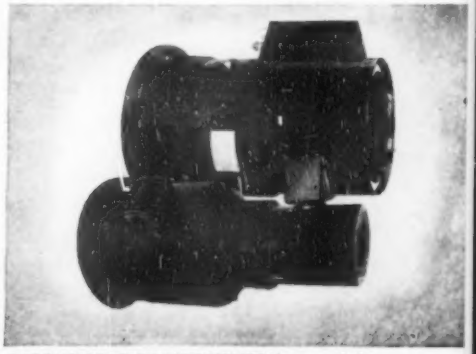
## LET G.E. HELP SOLVE *YOUR* GROUND POWER SUPPLY PROBLEMS



**FREQUENCY CHANGER PACKAGES** are available in 10-, 15-, 30- or 60-KVA ratings for the supply of 400-cycle power. Shown here in ground checking service, this unit is ideal for more accurate instrument and device testing or calibrating.



**MOTOR DRIVEN UNITS,** like this one in a jet engine test power room, are available in 265-, 500- or 1000-amp, 28-volt ratings. Suitable for mobile use or stationary installations, these units give you accurate and more reliable ground power.



**DEPENDABLE COMPONENTS** (a-c and d-c generators and motor-generator sets) are available for engine driven, self-propelled or stationary power units. Designed for you, they meet the most stringent government and civilian requirements.

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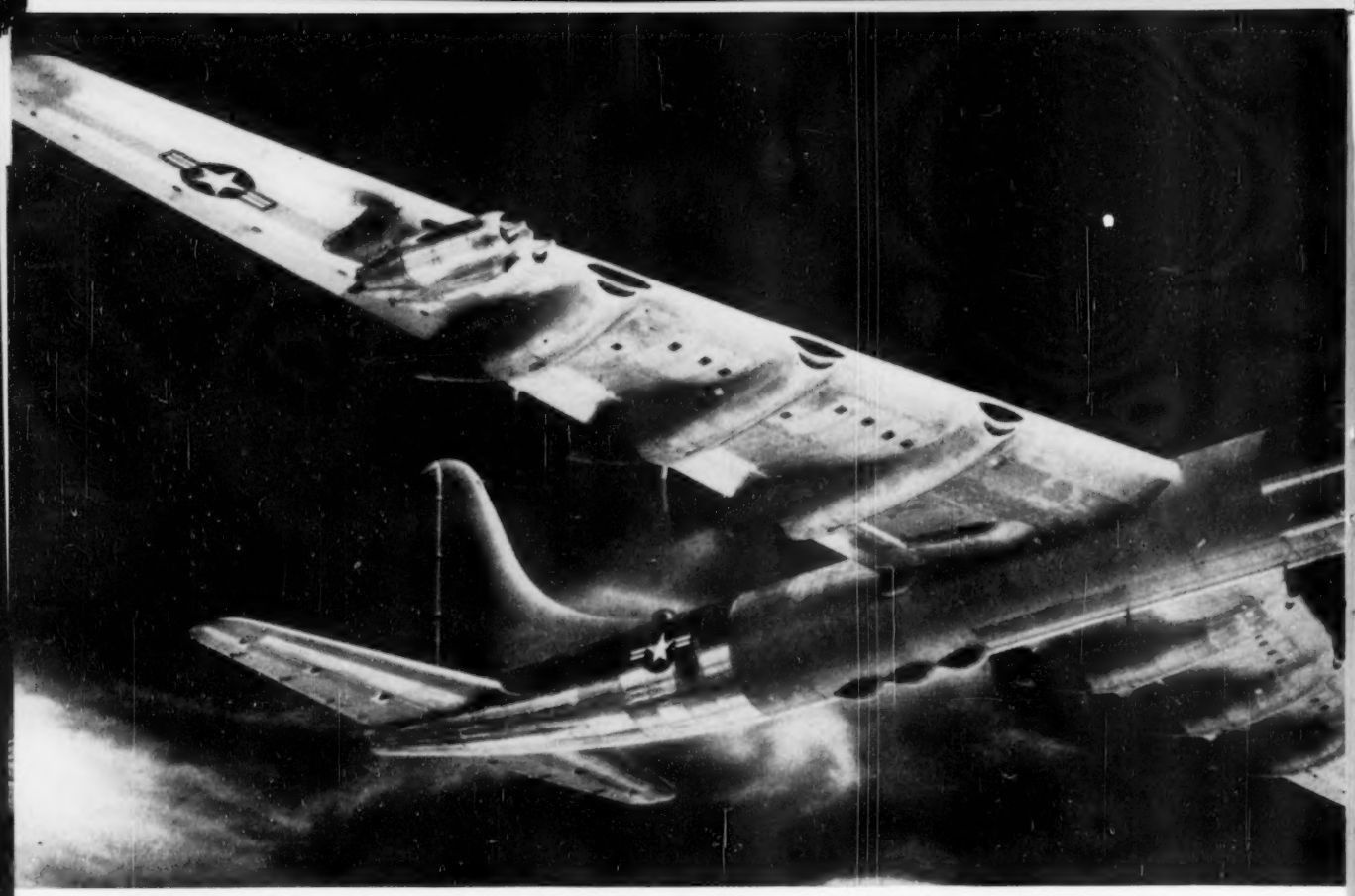


**THUNDERING B-36** symbolizes the combat readiness of USAF's major delivery system for atomic and hydrogen weapons.

# SAM-SAC Keeps B-36s 'Ready to Go'

By Frank Shea, Jr.

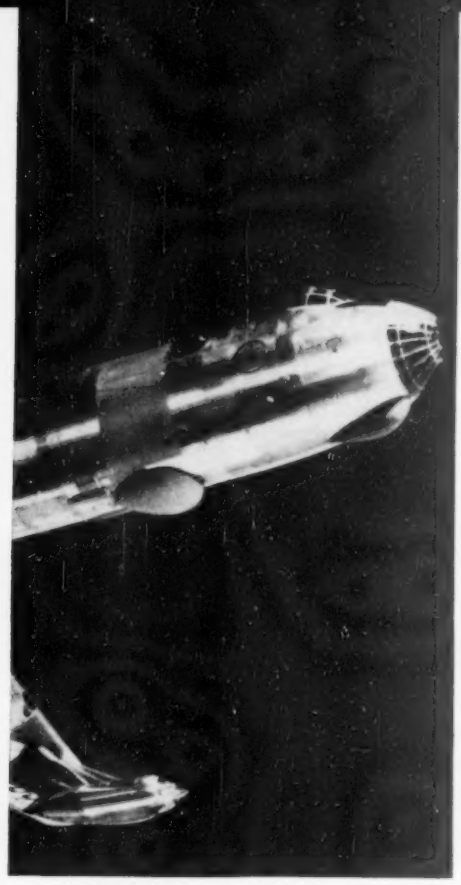
Fort Worth—If the whistle blows tomorrow for an all-out shooting war, this country's ability to administer immediate devastating retaliation would depend largely on the venerable B-36.

As the only heavy bomber now in operational service capable of carrying atomic and hydrogen bombs, the Convair giant shoulders responsibility for spearheading the striking power of the Strategic Air Command. Its ability to deliver atomic and hydrogen weapons over intercontinental range at the very outset could well spell the difference between victory and defeat.

No one is better aware of this responsibility than the people here at Convair's Fort Worth Division, birthplace of the B-36. Working closely with the Air Materiel Command they are doing everything in their power to insure that Gen. Curtis LeMay's striking force is primed and ready to go at a moment's notice.

This effort has taken on the concrete form of a unique $40-million-per-year

**SAM-SAC PROGRAM** begins here at the receiving station where all incoming aircraft receive inspection and inventory check.



overhaul, modification and modernization program involving an estimated 6,000 workers. Big emphasis is on modernization and reconditioning, but all necessary field level maintenance also is performed.

▶**SAM-SAC**—Known as "Operation SAM-SAC" (Specialized Aircraft Maintenance—Strategic Air Command), Convair's program is a result of the first contract of this kind to be awarded by the U. S. Air Force. Its demonstrated success thus far, coupled with the avid interest of other leading U. S. aircraft manufacturers, could well lead to a new overall Air Force maintenance concept.

SAM-SAC is a three-way deal, with SAC as the user, Convair as the contractor, and AMC's San Antonio Air Materiel Area as the supplier. All three coordinate and work together with the precision of a well-coached team. This, probably more than anything else, is the key to the program's success.

Convair has set up SAM-SAC so that the entire B-36 fleet can be run through the program in three cycles over a six-year period, with no more than about 30 aircraft out of service at any one time. Thus the striking capability of the long-range bomber fleet is never seriously impaired, and LeMay is assured of having his maximum strength "up front" at all times. Only 59 days are required, door to door, for any plane to go through a cycle, and Convair prides itself on the fact that it has never been late with a delivery in the two and a half years the program has been in existence.

## SAM-SAC Cycle

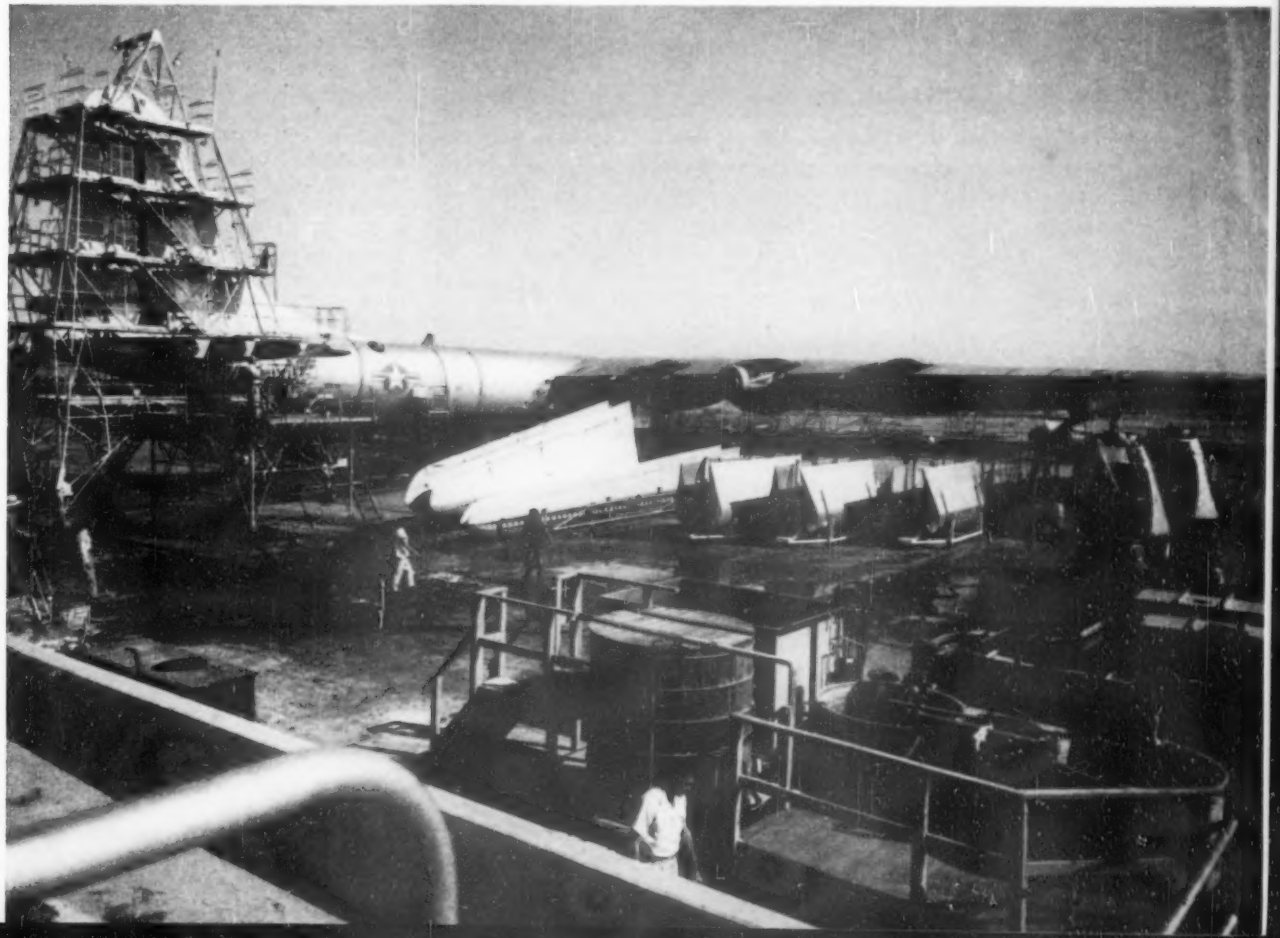
Actual work on any SAM-SAC airplane begins 10 days prior to the time it is received by Convair. At that time, the SAC unit to which it is attached forwards all of the ship's records to Fort Worth for examination and analysis.

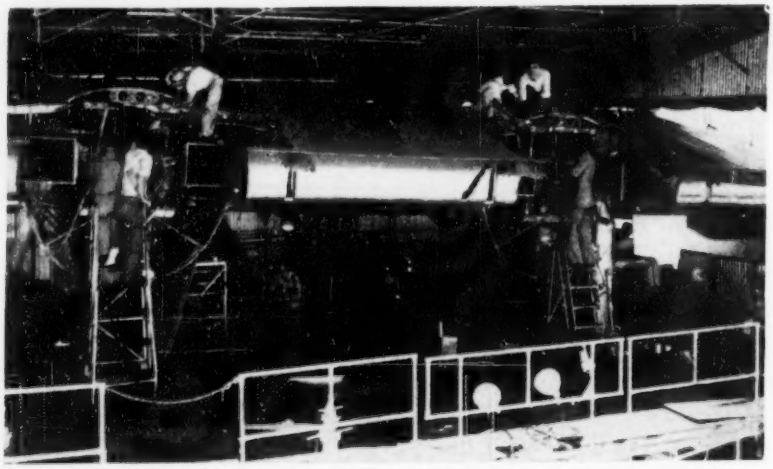
In this way, the SAM-SAC people are able to establish the major portion of work that the aircraft will require several days before its arrival. This saves precious cycle time, permits Convair to secure parts not on hand, and serves as an added incentive for SAC to keep all ship's records right up to date.

▶**Planning**—Convair planning begins here. Upon arrival, aircraft records go directly to the screening board, a permanent organization consisting of representatives from each of the major departments responsible for the accomplishment of SAM-SAC.

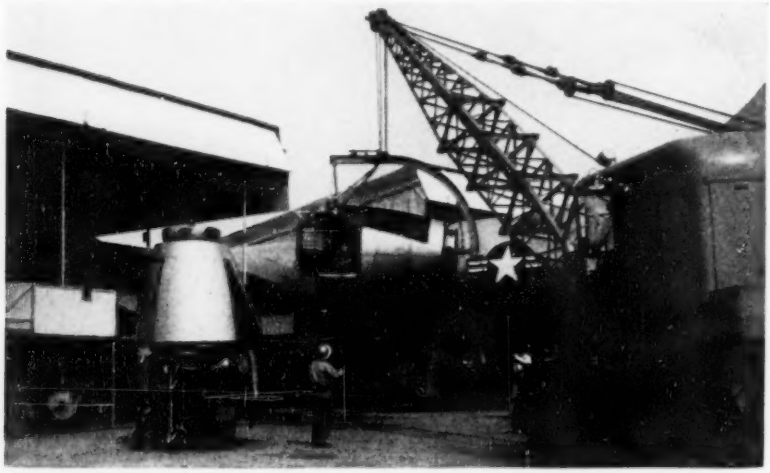
Sole purpose of this board is to es-

**STRIPPING** of reciprocating engines, control surfaces and other parts is accomplished at wash rack shortly after arrival.

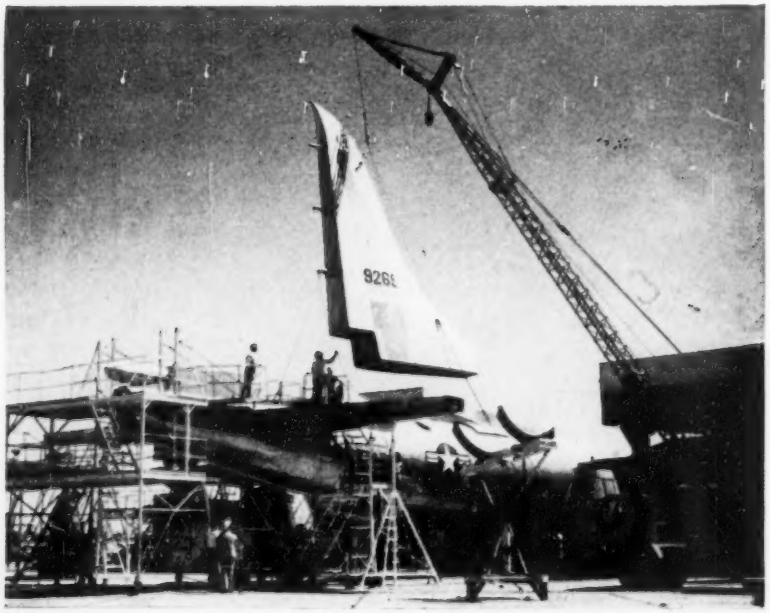




**DOCK WORK** begins as B-36 gets structures inspection and more parts are removed.



**P&WA R4360S** are removed and sent to reconditioning shop for a thorough going over.



**VERTICAL FIN** being installed on aircraft after extensive reconditioning and repair.

tablish and release an actual task (work to be accomplished during the specific cycle) for each aircraft and release supplements to this task for additions or deletions as dictated by the availability of kits.

In establishing the actual task, the screening board performs the following functions:

- **Screens receiving inspection records.**
- **Examines aircraft historical records.**
- **Checks service kit availability records, working closely with SAAMA.**
- **Screens malfunctioning parts report.**
- **Determines overage replacements and tech order incorporation.**
- **Establishes parts availability.**
- **Determines applicable ECPs (Engineering Change Proposals).**

Planning is the big factor. To obtain maximum efficiency, all elements in the SAM-SAC program are scheduled in a manner that allows perfect integration in order that each increment of work within the total task for the aircraft can be accomplished in the most logical sequence. Task planning is carefully monitored so that types of work are allocated to crews that specialize in particular skills.

Approximately 38,000 man-hours are devoted to each plane that goes through the program, which gives some idea as to just how extensive a job is done. Not only is all modification and modernization work performed, but all necessary field level maintenance tasks are accomplished as well.

The aircraft is completely checked from end to end, so that when SAC units get it back they know that they have a clean, serviceable ship that is "ready to go." This does not mean that a lot of unnecessary work is performed. The ship goes out clean and ready for service, but not like new.

►**No Face-Lifting**—Convair officials continually emphasize to personnel that they are not in business to make the planes pretty. As long as a part is completely serviceable, it stays, regardless of defacement, fading, discoloration, etc.

For example, illegible stencils, decals or nameplates are touched up or replaced. But faded or discolored decals or nameplates are acceptable if they are legible.

A variance of color blends in repaired areas also is acceptable, as are shock mounts with slight weather cracking or tires with small cuts which do not go through the cord. The same is true of tubing that has been bent or crimped on installation, but not broken—as long as flow is not restricted.

This "serviceable-but-not-like-new" policy saves precious man-hours and plays a big part in minimizing the amount of time an aircraft is kept out of service.

Since the entire philosophy of SAM-

SAC evolves around the progressive recycling of the B-36 fleet for modernization and reconditioning, inspection and reconditioning is progressively accomplished concurrently with normal maintenance during each of the program's three cycles.

▶**Divided in Three**—In order to keep the "down-time" of SAM-SAC planes to a minimum, Convair has divided each ship into three basic sections, one for each of the three cycles (see artist's sketch).

While one-third of the plane is undergoing modernization and reconditioning in a cycle, the remaining two-thirds receive a "field level" major inspection. In this way, each section takes its turn in its designated cycle, but the entire airplane gets a thorough going-over each time it comes to Convair's Fort Worth plant.

▶**Operation Intention Log**—Upon arrival at Convair, each B-36 first proceeds to the receiving station where a receiving shop has a list of all work necessary to prepare it for SAM-SAC. This information is issued in the form of an "Operation Intention Log."

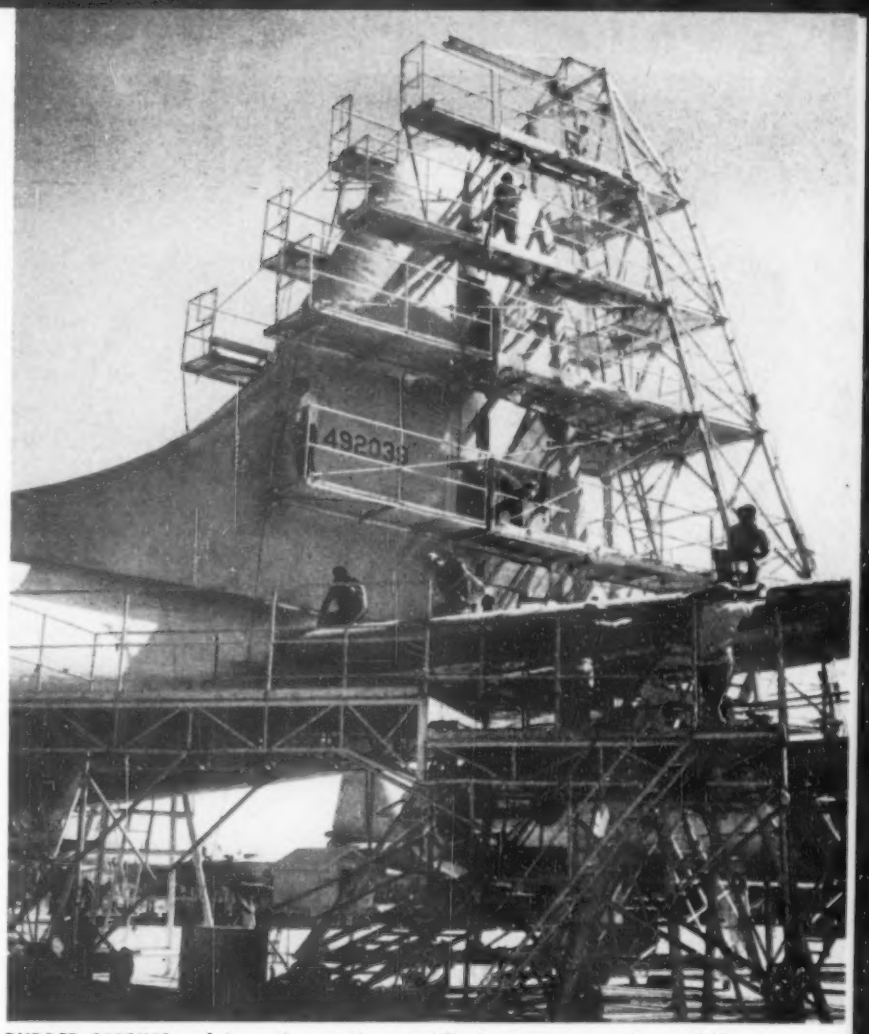
Inspection and inventory is then quickly performed. Electronic, armament and loose equipment is removed, and a visual and physical check is made to determine the general condition of the plane.

Next the receiving engine run is performed and engines are preserved for extended storage. A "power-on" check is made of the entire electrical system and operation equipment and all leading edges are removed. The amount of fuel received with the aircraft is then determined and posted as returnable to Air Force. Fuel and oil tanks are drained and flushed, and maintenance and preservation operations on the engines commence.

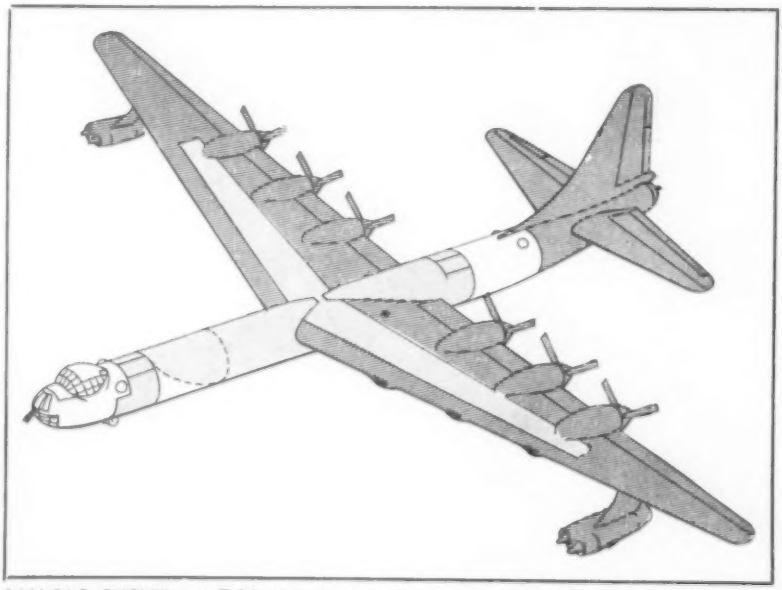
Second stop for the incoming B-36 is the purging station, where all fuel tanks are purged by drawing fresh air through the empty cavities to remove all explosive vapors. This operation is performed in a restricted area and only by personnel with specialized training. The aircraft then is checked for safety by the Fire Department through use of an explosimeter and proceeds to its next stop—the wash station.

Here, the propellers and reciprocating engines are removed and washed, as are the control surfaces. Interior and exterior of the ship is then cleaned and washed; all removed components are forwarded to their respective reconditioning areas, and then the airframe is forwarded to its specially assigned work dock.

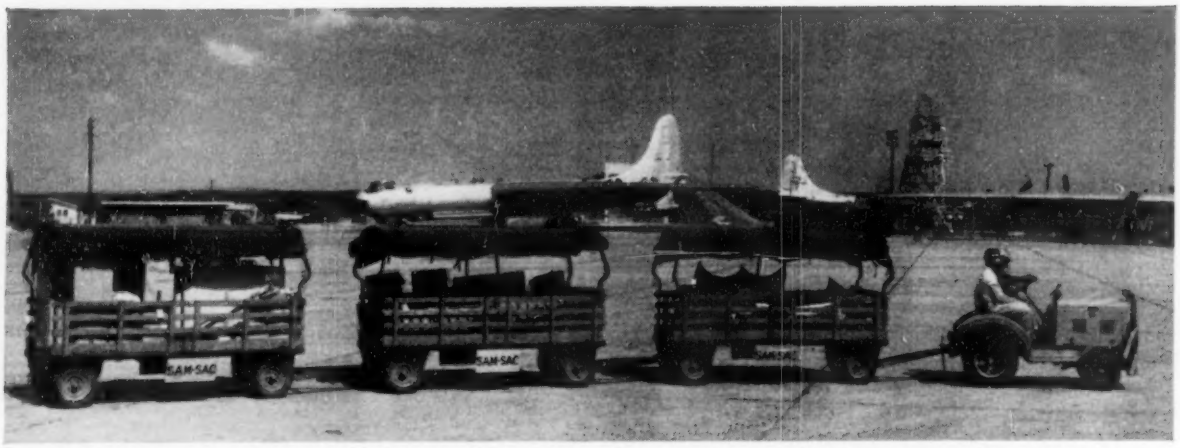
▶**Outdoor Work**—All SAM-SAC work docks are located outdoors, permitting many more planes to be worked on at one time, and also leaving the in-plant




**RUDDER RIGGING** and inspection requires specialized crews on complex scaffold.



**SAM-SAC CYCLES** cut B-36 into three sections, with each third undergoing overhaul and modernization in its own turn while the other sections receive field maintenance.



**SPECIAL TRAIN** operates a shuttle service, delivering B-36 airframe and engine parts to work docks and reconditioning shops.

production facilities free for actual production planes.

While the last B-36 production model was rolled out this month (AVIATION WEEK Aug 9, p. 15), Convair officials want to make sure the line is free and ready to go—especially since the B-58 Hustler development program has gone in high gear (AVIATION WEEK May 24, p. 13).

▶ **Shops and Docks**—Once the removed component parts have been sent to their respective reconditioning shops and the airframes sent to their work docks, the real work of SAM-SAC begins.

In the reconditioning shops, elevators are disassembled—trim tabs and servo tabs being removed, along with access doors and electromechanical over-age items—and all control mechanisms, etc., are closely inspected. All necessary work is then accomplished prior to reassembly.

In the rudder, aileron and flap shops, similar processes are repeated, with all units undergoing rigid inspection upon reassembly.

▶ **Armament Examination**—Armament comes in for special attention, with all turrets and fire control equipment being shipped to specific government contractors for modification and maintenance.

The guns are disassembled, reconditioned, repaired, reassembled and all mechanisms are functionally checked with dummy ammunition.

Upon receipt of the modified turrets and equipment, workers mount each unit on a test stand for functional and continuity checks. Interruption tests are performed on each turret.

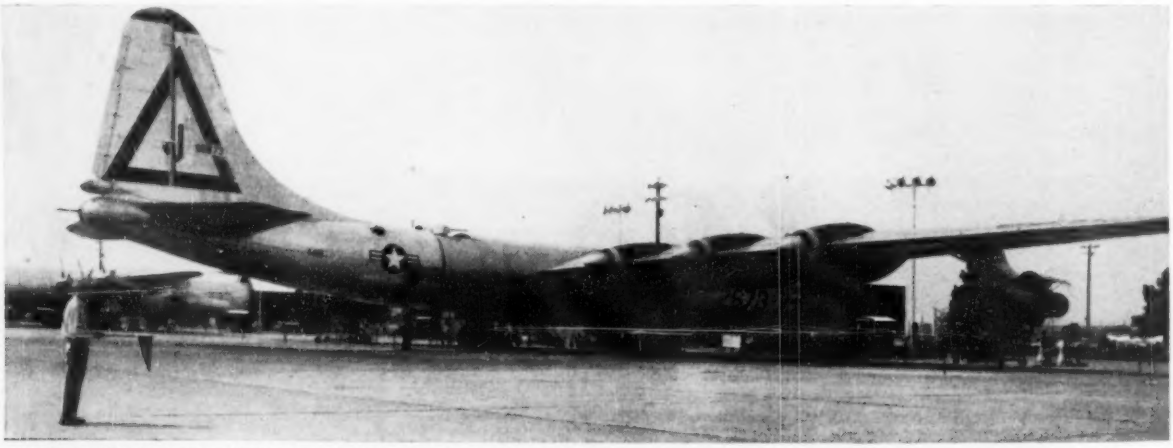
The guns are then mounted, boresighted and harmonized. All sights are synchronized and checked, and lead checks are performed on each computer. All turret controls and related equipment are adjusted, operated and inspected for reinstallation on the aircraft.

The electromechanical and hydraulic shop handles the reconditioning of all malfunctioning electromechanical and hydraulic items removed from the ship. Reworks are limited to field-level-type repairs that are within Convair's capabilities, while items requiring more extensive repairs are returned to the appropriate AMA depot.

▶ **Avionics Maintenance**—In the avionics area, too, the extent of rework or repair performed is limited to a field-level nature within Convair's capabilities, with all other work being forwarded to the appropriate overhaul depot.

The electronics laboratory at Convair screens equipment removed from each aircraft to eliminate any outdated or malfunctioning units requiring extensive repair. Preventive-type maintenance then is performed on all other equipment. Foreign matter is removed and inspection is made for loose connections, worn plugs, malfunctioning tubes or parts and condition of wiring and brushes. Each unit is rewired and lubricated as required.

Each item is checked for applicable tech order compliance. All applicable TOs, engineering change proposals and other directives, within Convair's capabilities and not previously accomplished,



**ALMOST READY,** having finished work dock phase, SAM-SAC aircraft is prepped prior to undergoing extensive flight testing.

are incorporated in the equipment at this time.

Last stop before equipment is ready for reinstallation is a bench-type functional check to assure proper operating condition within an entire system.

▶ **Props & Powerplants**—On propellers, Convair governs the extent of disassembly by the actual age of the unit and the number of tech orders open on it. All extensive repairs and major overhaul are performed by San Antonio Air Materiel Area.

Engines get a real going over, with the powerplant, as received from each SAM-SAC aircraft, being dismantled into three basic components—the cowl structure, the engine, and the mount assembly.

As the components are separated, the cowl structure and engine are forwarded to their respective areas for further disassembly to permit cleaning, reconditioning and the incorporation of service kits.

The mount assembly remains on the nacelle dolly to undergo its own extensive reconditioning operations. A sheet metal repair shop is located in the area to expedite cleaning or repairs necessary on any components or parts that are being removed from within components.

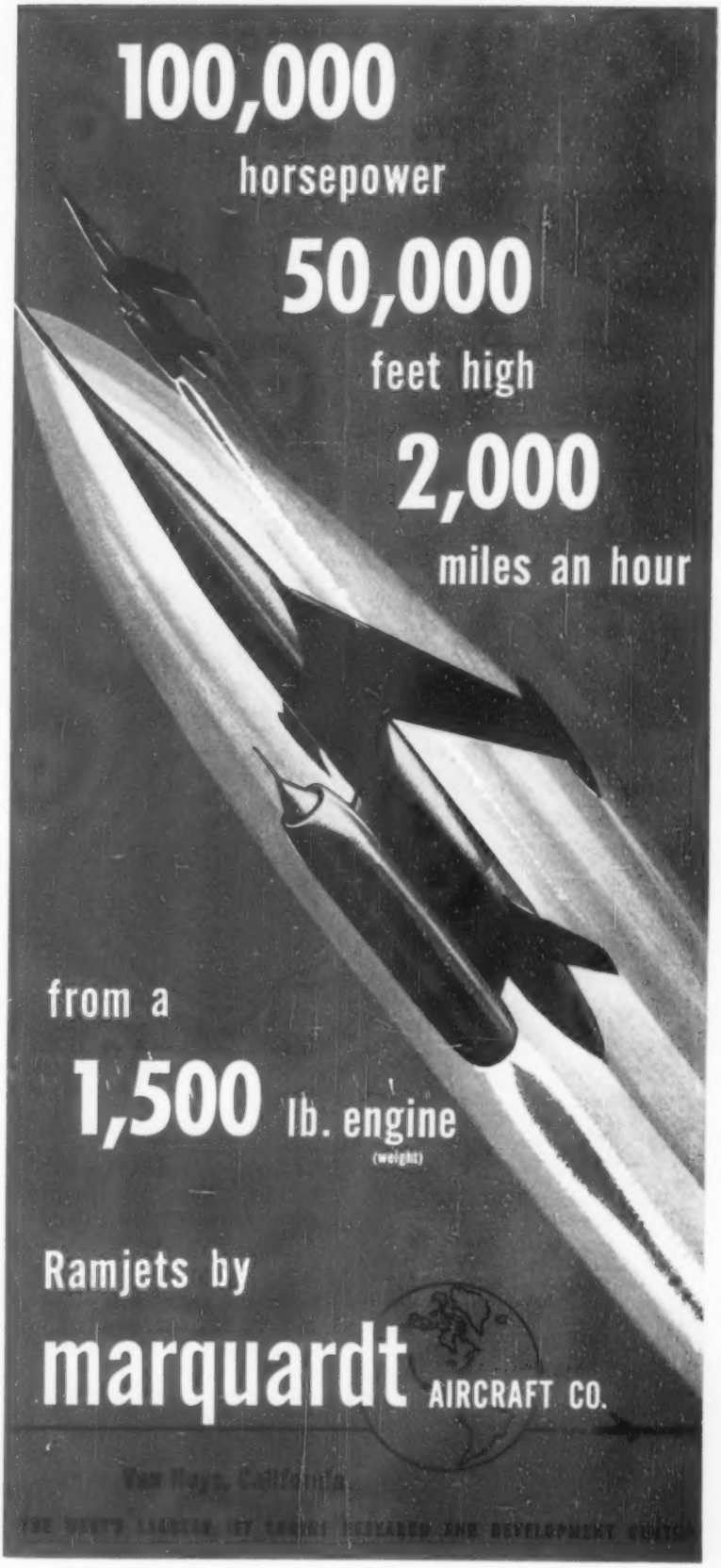
While all this is going on, dock workers are busy putting the airframe through its paces at the work docks—performing maintenance, reconditioning, modernization and reassembly operations necessary to conform to the predetermined task.

▶ **Dock Areas**—In order to understand the actual work dock operations, a brief description of the dock areas themselves is necessary.

Since they are outdoors, these docks had to be especially designed to protect personnel and equipment from the elements throughout continuous year-round operation. Also, they had to be designed to provide the necessary scaffolding and platforms for accessibility to all exterior surfaces of the wing and nose sections of the aircraft.

The size of the B-36 presented a tremendous problem in the design of such a work dock station. Convair's solution incorporates all these features:

- **Storage racks** for all assemblies and parts being removed, for accessibility and easy reinstallation.
- **Stock room** with personnel to receive, file and control the planning operation cards, service kit and standard parts to be installed on each aircraft that is to be reconditioned.
- **Area furnished with sheet metal** equipment and materials necessary to fabricate maintenance-type parts for minor repairs and perform cleaning operations as required.
- **Provisions for stowing** service tools,



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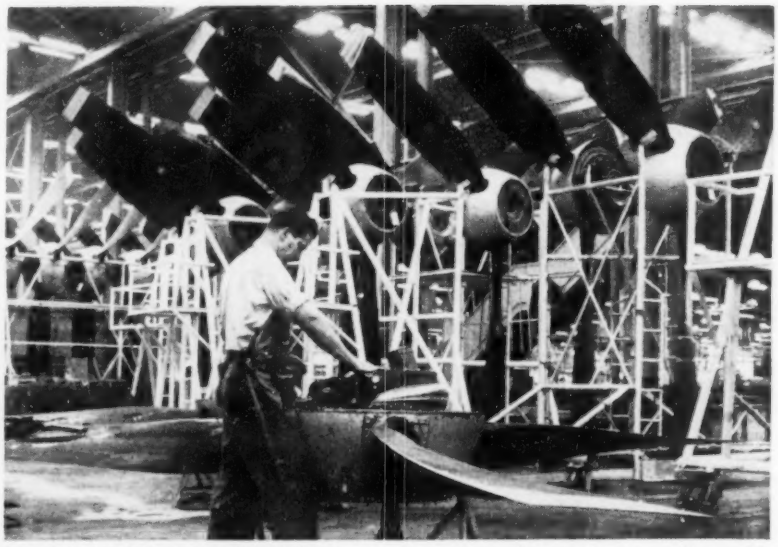
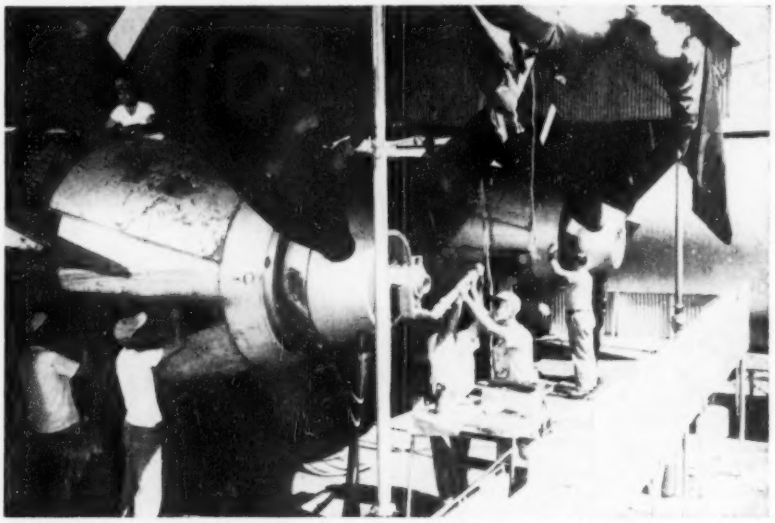


**SAM-SAC PROPELLER REWORK AREA.** Convair governs the extent of prop disassembly by actual age of the unit and number of tech orders open on it.



**PROPELLERS ARE REINSTALLED** after major inspection during SAM-SAC cycle. All extensive repairs and major overhaul are performed by San Antonio AMA.

field mechanics tool chests and various types of personal foul weather gear.

• **Heating, airconditioning** and fresh-air blowing units to further expedite the all-seasonal operations.

• **Field office** areas for shop supervisory personnel.

▶ **Shores & Jacks**—Prior to actual dock work, SAM-SAC aircraft are shored, leveled and secured within each dock station, in readiness for the dock phase to be accomplished.

Shoring equipment consists of field jacks, stabilizing towers, stub blocks and mooring cables. The plane is raised by inflating the main landing gear struts, supplemented by a nose jack. A steel stub block and pad are inserted under each main landing gear column to support the aircraft in the raised position.

Deflation of the struts elevates the wheels to a raised position. Field jacks and towers are positioned at designated points for additional support and to insure against any movement of the positioned aircraft. Convair isn't taking any chances after the disastrous tornado of September 1952 that knocked more than 70 of the big intercontinental bombers out of commission.

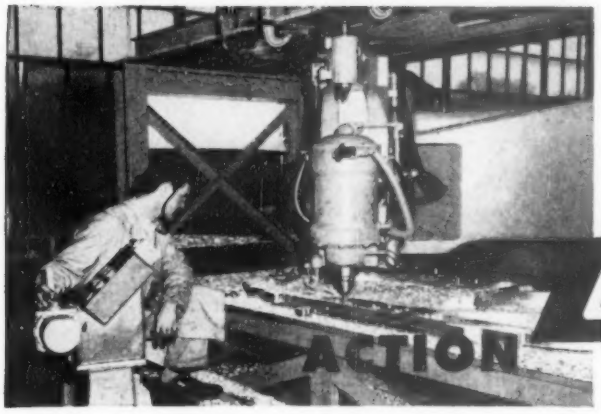
## Dock Operations

The "in dock" period represents a large percentage of the total elapsed time for an aircraft in SAM-SAC. Progress has to be accurately measured in order to insure that schedules are met without aircraft overstaying its dock time.

▶ **Six Phases**—For this reason, Convair

# MAKING THE CHIPS *FLY*

**ON BIG MACHINED-FROM-SOLID ALUMINUM PARTS FOR AIRCRAFT**

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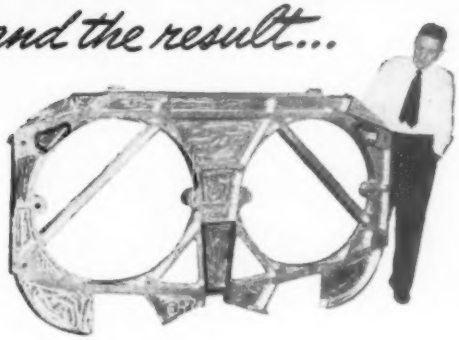
*and the result...*



## MORE ACTION

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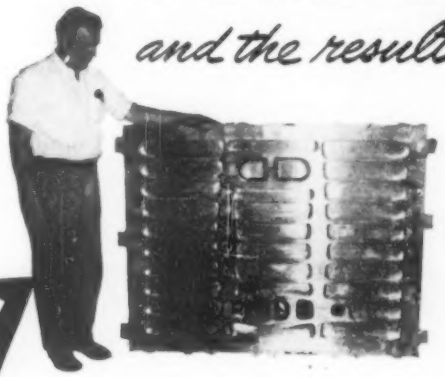


## FOR GREATER AIRCRAFT PRODUCTION!

divides the work task on each ship into six separate phases. Each phase represents a block of pre-planned work, scheduled to be completed prior to entry into the next phase. All work paper is released by phases subdivided into airplane sections or types of skills in order to gain maximum utility from each man-hour.

While the ship is in the dock, seven fixed crews are assigned to specific sections of the aircraft to perform general-type aircraft work. These crews, in turn, are supplemented and supported by specialized crews that perform work of given skills.

Five of the fixed crews are assigned to the nose, bomb bay, tail, wing, and pods, while the remaining two are assigned to three engines each. The supporting specialized crews work over the armament, electronics, sound-proofing, paint, sealant-oil barrels, sealant wing tanks, auxiliary fuel cells, rigging, electrical operations and the hydraulic systems.

▶ **Phase One**—The leveling, shoring and tiedown operations are accomplished in Phase One of the work dock sequence. In addition, all areas are opened up and a thorough inspection is made to determine the required maintenance task.

This task is integrated into subsequent phases concurrently with the planned modernization task.

Additional preparation-type work is accomplished in this phase by removing parts or assemblies in the following categories:

- **Over-age items.**
- **Malfunction items** (flight squawks and receiving inspection replacements).
- **Obstructional removals** (items removed to prevent damage or allow accessibility).
- **Obsolete items** to be replaced by new configuration.
- **Damaged replacements.**
- **Rework items** (items which are more economical to repair "off-ship").
- **Test requirements** (items which must be tested and checked out on "bench type" equipment).

Wing integral tank work also is performed, consisting of structural and sealant and structural rework in the oil barrels.

▶ **Phase Two**—Moving into Phase Two, installation of kit and replacement parts and assemblies of a structural and primary nature is accomplished concurrently with reconditioning and maintenance-type repairs of the same category.

Reconditioned reciprocal engine nacelles, propellers, rudder and elevators are reinstalled and rigged, while the jet powerplants are inspected and reconditioned. Over-age and unserviceable items are replaced, all hanger bolts are removed and magnafluxed, and serviceable bolts are reinstalled.

Outer panel and stabilizer leading edges are reinstalled, as are the wing and stabilizer tips, while wing integral tank work in this phase consists of structural rework in the wing tanks and injection of voids. Oil barrels are air-tested.

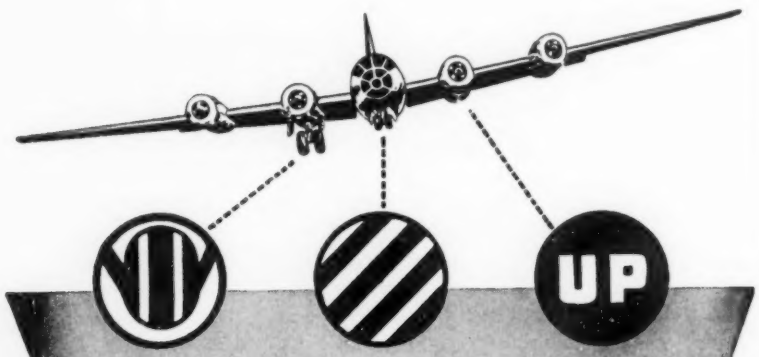
▶ **Phase Three**—This phase is concerned with the installation of electrical and plumbing kit and replacement parts concurrently with the reconditioning and maintenance-type repairs of the same category. In addition, reconditioned flaps and ailerons are reinstalled and rigged, while auxiliary fuel cells are reinstalled and tested.

The interior paint is then touched-up, wing tanks are air-tested and the oil barrels are flushed.

▶ **Phase Four**—In this phase continuity checks are made on all electrical systems, while pressure tests are made on all systems.

In the next step, electrical operation checks are run on all bomb-bay turret doors and engines, the soundproofing, decals and carpeting are installed and cleaning of all areas progressively begins in preparation for the final acceptance inspection.

In this same phase, the outer panel of the wing is inspected. If accepted by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3-POSITION INDICATOR

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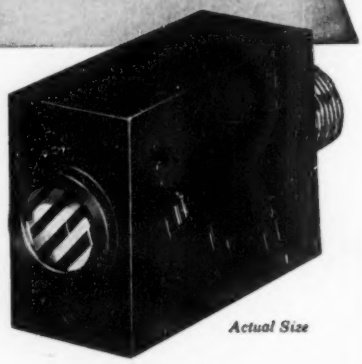

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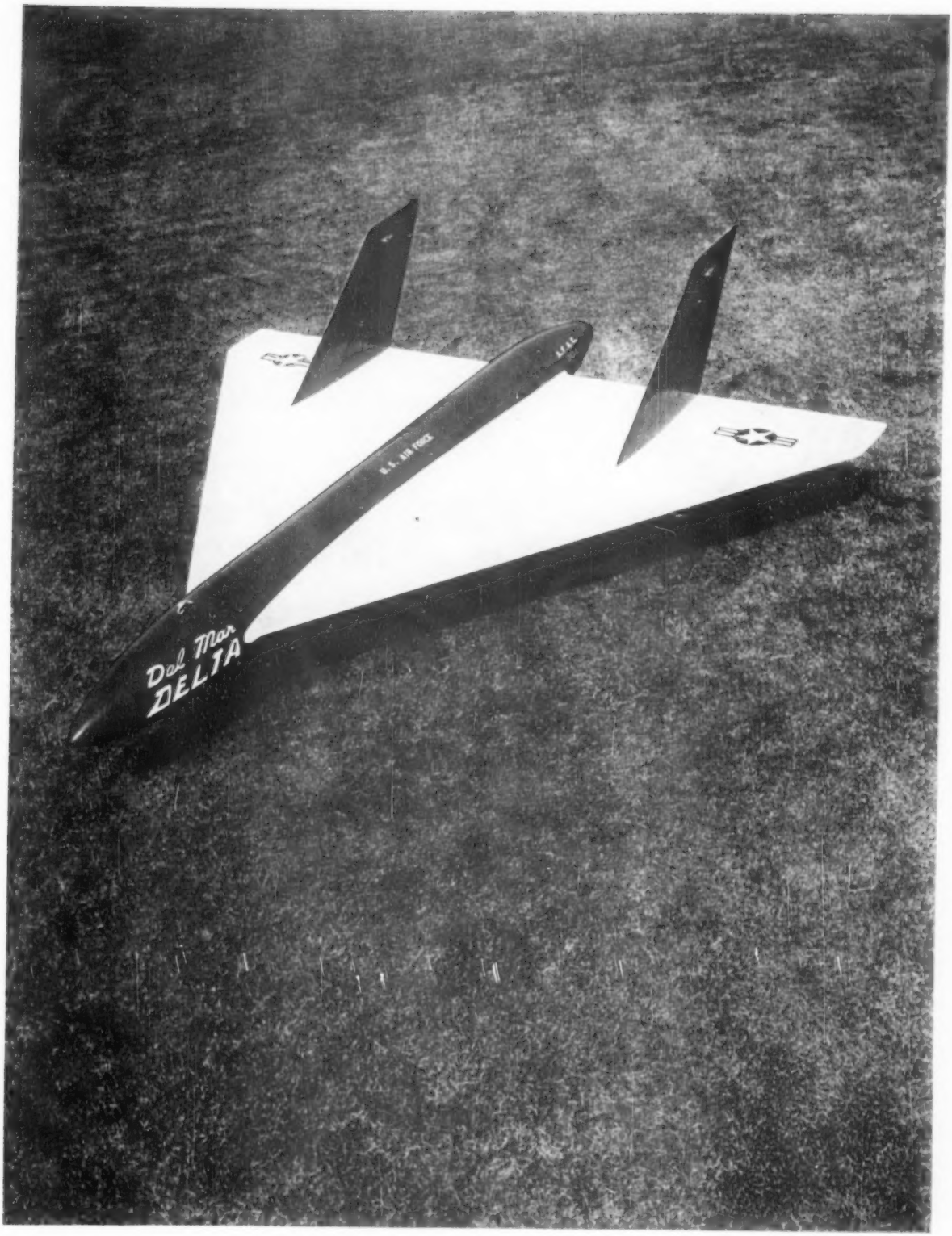
- Filled with inert gas
- Optically clear glass window
- Corrosion resistant finish

RIVERSIDE

*For additional information, write to:*

KEYSTONE WATCH CASE DIVISION
RIVERSIDE METAL CO.
*Riverside, New Jersey*




AMERICAN LATEX' NEW STAFOAM

From a liquid — poured-in-place: the strengthening core for thin airfoils. (See next page.)

# STAFOAM PROVES SUPERIOR

## for Strengthening Core of Thin Airfoils

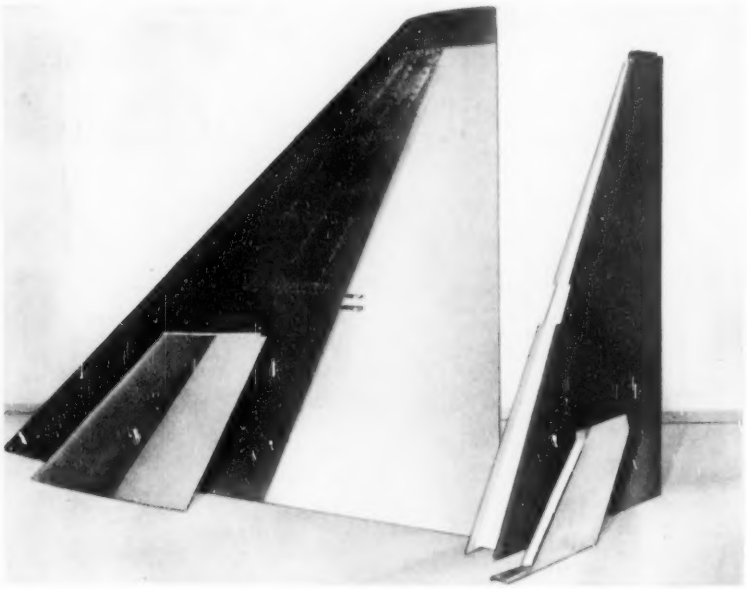
STAFOAM was selected as the core material in major portions of the thin airfoil sections of the Del Mar Delta target.

Del Mar Engineering Laboratories specializes in advanced target design. After evaluating the highly sensitive and accurate fire control systems now under development, Del Mar engineers selected STAFOAM. This target was designed to meet the requirements of the Air Force's Armament Center for a structure capable of utilizing various scoring devices and performing economically at the speeds and altitudes compatible with anticipated operations. STAFOAM proved definitely superior on the basis of simplicity, low material and fabrication costs, high structural strength, limitation of weapons damage, smoothness of skin surfacing, and floatation for water landings.

Del Mar Delta in flight.

"STAFOAM core on our Delta structure has proved rugged, even with the severe handling and abuse associated with target launchings and landings. We predict a great and expanding future in the aircraft industry for this fine new material, and especially feel that it should find important new applications in the field of thin airfoil structures," states Mr. R. J. Hopper, Del Mar Chief Engineer.

## No Other Strengthening Members Required



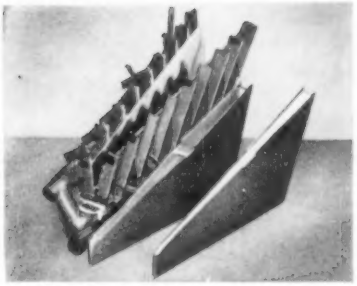
Largest section is complete wing. Trailing edge (right) is entirely reinforced with STAFOAM as indicated by absence of rivets. Second-largest section (extreme right) shows STAFOAM core in same trailing edge. Small section (left front) shows STAFOAM reinforced trailing edge of upper vertical stabilizer. The remaining small section is the trailing edge of the lower vertical stabilizer which also has a STAFOAM core.

Light weight, cellular plastic Stafoam adds strength by bonding all surrounding members into a super strong unit in addition to supplying extra rigidity. Unlike most foam products, its cell structure is of a non-connecting type, making it moisture-resistant. *(Photos courtesy Del Mar Engineering Laboratories, West Los Angeles, Calif.)*

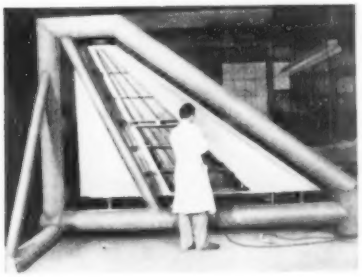
## Stafoam is Simple to Use

Here workmen are pouring the entire core of the trailing edge of the Del Mar Delta wing.

Nothing can be simpler than to pour liquid into the cavity of the part that is to be strengthened. STAFOAM does away with the parts and labor used in the conventional methods of strengthening. No more cutting and shaping a core and then painstakingly fitting other structural members around the core material. Engineering time is also reduced. Quickly trained workmen can pour liquid into the cavity which is to be strengthened. STAFOAM sets into a strong, lightweight core that does the job all by itself.



From left to right: (1) Open jig of Del Mar Delta wing section. (2) Skin of same wing section before core is poured. Note that no interior strengthening members or reinforcements are necessary. (3) Finished assembly. Stronger, lighter, smoother, and more economically produced.



Jig for riveting that section of wing not reinforced with STAFOAM.

**NOTE**

Because of space limitations in this ad, information is necessarily incomplete. STAFOAM is supplied in hundreds of variations in density, texture, color, strength, insulation and thermal characteristics. For more general information on this truly miracle foam plastic, write for your STAFOAM brochure.

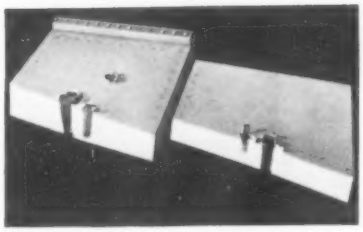
# Stafoam Can Be Formulated To Produce Astounding Variety of Physical Properties

**Only a fraction of its applications have been discovered.**

STAFOAM is the name applied to all foamed-in-place plastics manufactured by American Latex Products Corporation. It is truly a miracle material! Its applications are so varied, and the results obtained in extreme conditions are so gratifying that it will revolutionize many manufacturing methods and procedures. At present STAFOAM is produced in three major types: (1) Rigid Alkyd STAFOAMS, (2) Rigid Phenolic STAFOAMS, (3) Flexible Alkyd STAFOAMS.

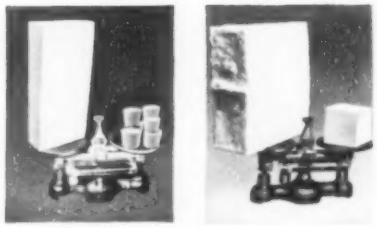
STAFOAM can be formulated to produce an astonishing variety of materials—from substances so dense that it is difficult to distinguish them from metals, through all degrees of density, to materials so porous that they weigh less than 1½ pounds per cubic foot. Besides the rigid types, materials can be formulated that are either flexible or resilient. Some return to shape slowly, others are difficult to distinguish from natural foam rubber.

## Shatter Resistant



Cross section through STAFOAM-filled aileron showing firmness and lack of crumbling near holes made by .50 caliber machine gun bullet.

## Light Weight



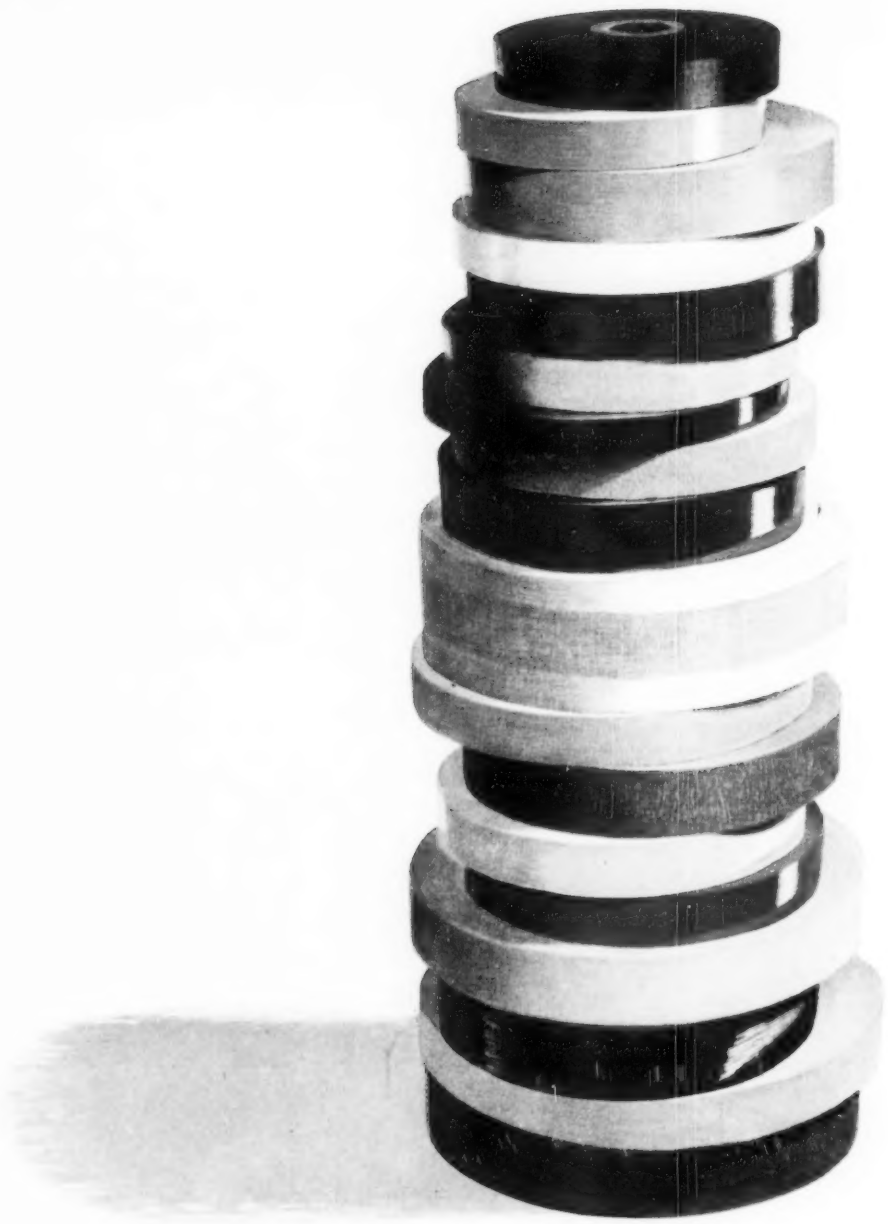
Extreme light weight of this Stafoam formulation is shown (at left) in relation to weight of cork. The small sample and the large sample (right) weigh the same, further emphasizing wide range of densities possible in Stafoam formulations.

Rigid Alkyd STAFOAM is highly shatter-resistant. Structures reinforced with Rigid STAFOAM also have extraordinary vibration-resistance at working frequencies and amplitudes encountered in many industries.

**STAFOAM, a registered trademark of American Latex Products Corp., is manufactured under *LOCKFOAM patents owned by Lockheed Aircraft Corp., Burbank, Calif.**
** Registered Trademark of Lockheed Aircraft Corporation.*

American Latex Products CORPORATION

**3341 West El Segundo Boulevard • Hawthorne, California**



**whatever the job . . .**

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both Convair and Air Force, it is closed up complete. Application of sealant in the wing tanks and oil barrels winds up Phase Four.

▶ **Phase Five**—In Phase Five, all items previously removed to prevent damage or allow accessibility are reinstalled and remaining electrical operations are accomplished. In addition, armament equipment is installed and operated and the electronic equipment is put back and continuity checked.

All of these areas are then inspected and approved by Convair and Air Force and are closed out. Final operations of Phase Five see the wing installation completed and leading edges reinstalled, paint and putty operations performed as required, and the wing tanks and oil barrels closed out.

▶ **Phase Six**—Approaching the finale, the aircraft leaves its dock location in Phase Six. First operation is the positioning of the ship just outside the dock where it is placed on jacks for test operation of the landing gears.

Then, with the accomplishment of all hydraulic operations and their final acceptance, the aircraft completes the dock cycle. Next stop is the electronic station for final electronic and armament checks.

▶ **Final Checks**—At this point, final preparation begins for reinstatement and return of the aircraft to a commission status with Air Force. While it is still at the electronic station, the following is accomplished:

- **Itemized list** of all work performed is placed aboard aircraft.
- **Electronic equipment** is operated and checked.
- **Final operations** are performed on all armament equipment.
- **Harmonization of sights** and interruption checks are performed at this time.
- **"Compass rose"** operation is performed to calibrate and set compass readings.

Looking more like a complete aircraft now, the giant B-36 is towed to the preflight station, where its exact weight is established and it is serviced with fuel and lubricating oil and checked for possible leaks.

Reciprocating and jet engines are then reactivated to an operational status and an engine acceptance run is performed. All instruments are calibrated and checked while engines are being operated.

Next, the anti-icing and electrical systems are checked and operated and the complete airframe, controls, control surfaces and engines are checked to safety standards.

Ground checks finished, the aircraft is released for flight operations and begins flight tests.

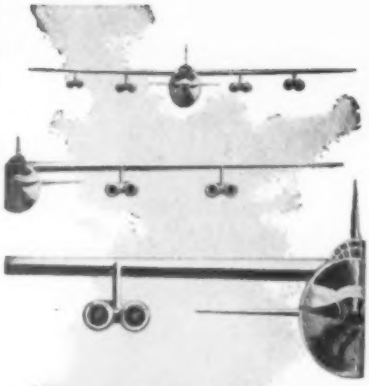
Upon completion of flight tests, all mechanical, electronic and armament adjustments resulting from flight performance are accomplished and service operations are performed on all engines.

Tanks are replenished with fuel and oil and all areas are again inspected for leakage. Complete aircraft and controls are rechecked to safety standards.

Now the aircraft is almost ready. A final adjustment of controls, a last-minute engine check, a final servicing and the SAM-SAC cycle is completed.

A SAC crew climbs aboard, revs up the engines with a mighty roar, and another intercontinental giant is on its way back to General LeMay's long-range atomic striking fleet—ready to go!" ■ ■ ■

**'READY TO GO,'** intercontinental B-36 bomber climbs after SAM-SAC cycle.

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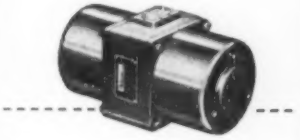

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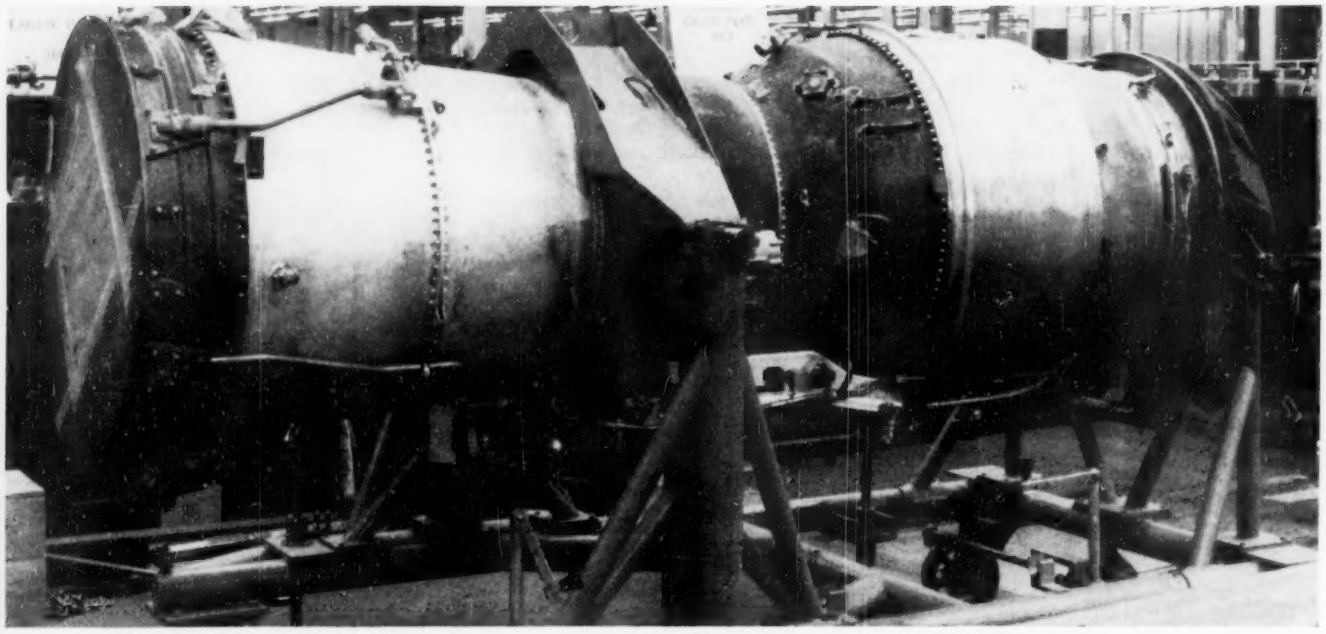


**FIRST P&WA J57** overhauled at Tinker AFB gave shop personnel familiarization needed for future workload with these engines.

# Tinker Makes Jet Engines Good As New

**Oklahoma City—Operation of the world's largest jet engine overhaul facility at Tinker AFB is one of the big responsibilities of AMC's Oklahoma City Air Materiel Area (OCAMA), commanded by Maj. Gen. W. O. Senter.**

**Tinker's Engine Overhaul Branch, Maintenance Division, receives its jet engines from worldwide Air Force activities, and Tinker's supply depots ship the overhauled powerplants back to these scattered points over the globe.**

The overhaul facility occupies about 25% of a 38-acre windowless, air-conditioned building. It handles the Allison J35 exclusively (except for some Allison work on the –29 model) and General Electric's J47-25 and –27. Ratio of engines passing through the facility now is about two J35s to one J47.

(San Bernardino Air Materiel Area overhauls early J47s, Middletown Air Materiel Area processes Allison J33s and some Pratt & Whitney J48s.)

► **Set for the J57**—Tinker's overhaul facility now is preparing to take in the Pratt & Whitney J57 jet. Tinker probably will be the only base for J57 overhaul. First group of this powerplant will be the J57-P-1s.

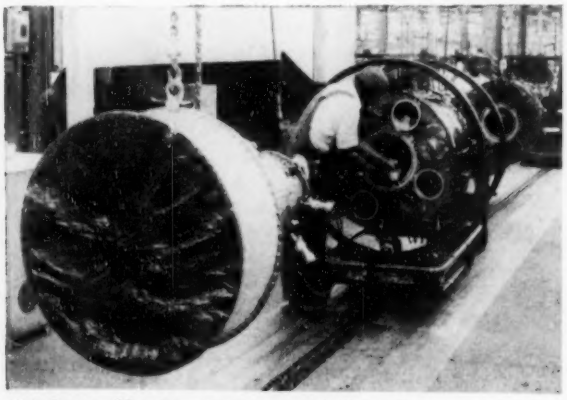
One of these engines already has been received and overhauled at Tinker, furnishing at the same time the required familiarization training for the facility's shop personnel.

Tinker expects to receive a reasonable volume of the J57s for overhaul beginning in January 1955. This will coincide, roughly, with the beginning of overhaul phase-out of the J35s. The number of J57s expected to be received at the base initially will be about five per month.

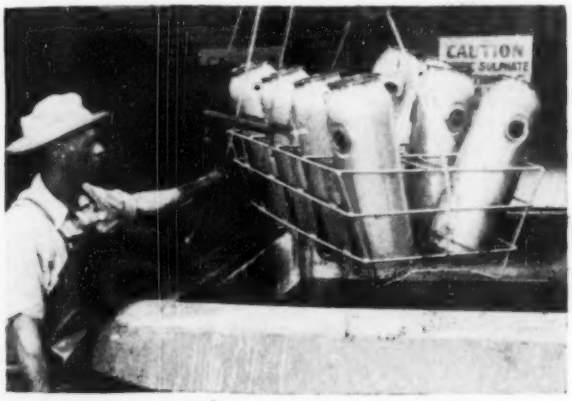
In readiness for the J57s, alterations and rearrangements already have been made in the overhaul shop. The accessory overhaul section is in the process of receiving new equipment for test and calibration of the J57s. This equipment is for the 35 or so engine accessories, including such items as the main and emergency turbine controls, governors, lube and fuel pumps, etc.

Shop equipment for this engine will include a new parts washer, vertical lathes for machining mating surfaces of major components, and balancing equipment. Test cell facilities now being readied will meet the new load imposed by the processing of the new engine.

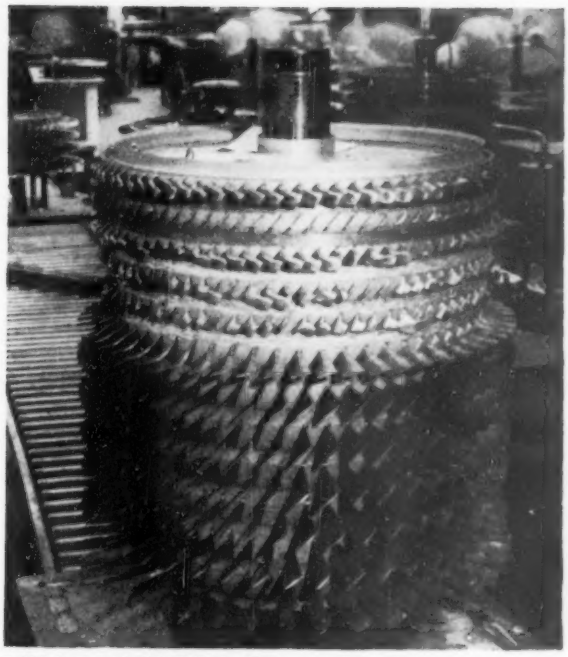
A big maintenance program complementing OCAMA's overhaul job is the



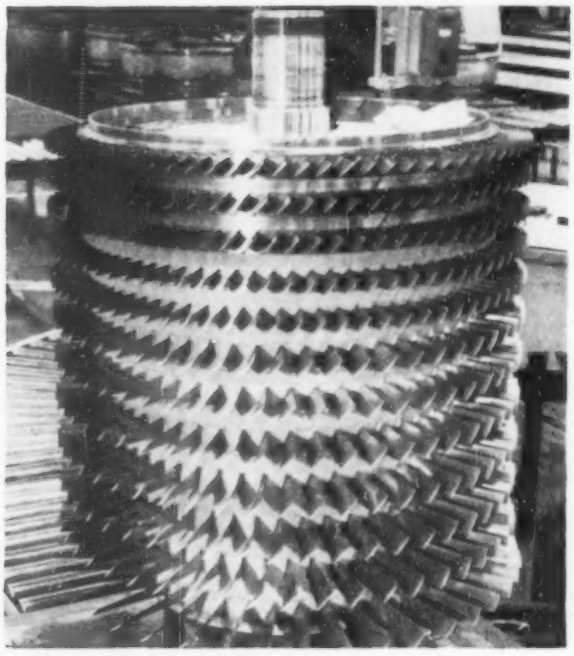
**J35** disassembly takes aft frame from dollied midframe.




**ACID DIP** cleaning bath for outer combustion chambers.



**DAMAGED COMPRESSOR** illustrates Tinker's jobs.



**OVERHAULED COMPRESSOR** ready for acceptance.

field maintenance phase (also known as minor repair) for jet engines.

## Field Maintenance

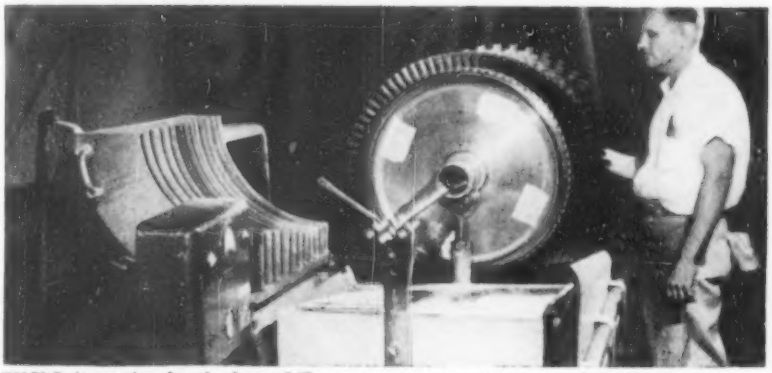
This program is intended to accomplish replacement at base level, of relatively short-life, hot-section parts of the jet engine. Such parts include, generally, units from the midframe aft. (External parts, such as accessories, have always been replaceable in the field.) Field work is followed at base level by an operational test.

The program began in 1949, when Air Force overhaul facilities began to feel the full impact of the jet program. Workload became quite heavy and the deployment of jet aircraft to overseas bases put a serious strain on the supply of jet engines. It took seven months for engines from the Far East to return to the U. S., undergo overhaul and return to service. For European units the time was five months. An unusually large number of engines was required just to fill the "pipelines."

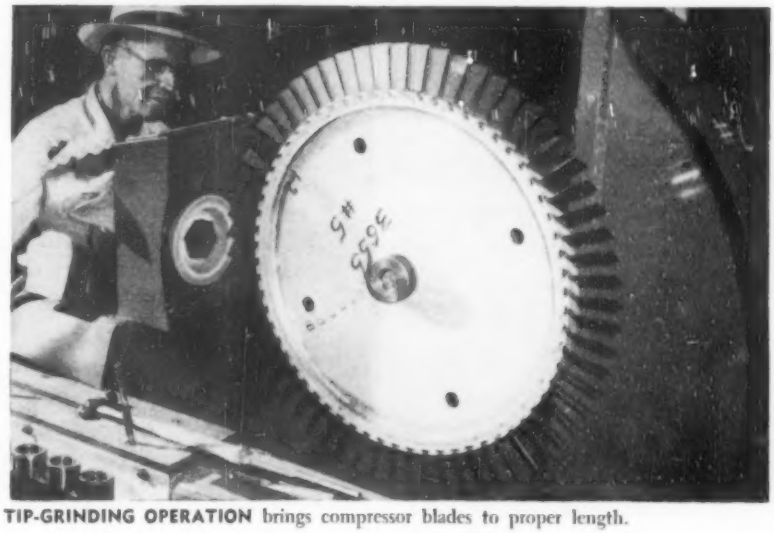
► **Worldwide Responsibility**—Jet field maintenance was taken over by OCAMA under AMC decentralization in September 1952. OCAMA's jurisdiction in the field maintenance phase applies to all USAF turbojets all over the world.

The program for field maintenance of jet engines has shown these big advantages:

• **An increase of more than 50%** in average time between overhauls has been achieved in the past three years. This condition is reflected in Tinker's,



**ZYGLO** inspection booth shows J47 compressor rotor after removal from solution.



**TIP-GRINDING OPERATION** brings compressor blades to proper length.

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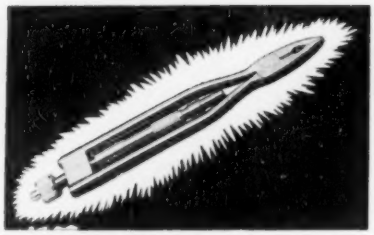

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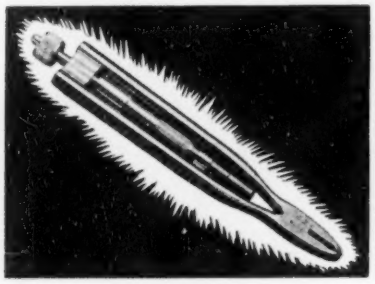

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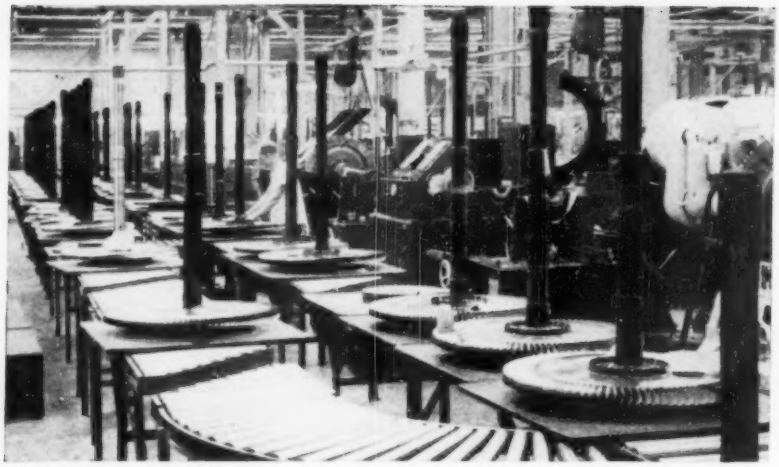
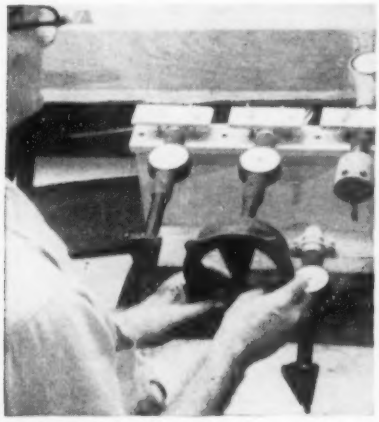
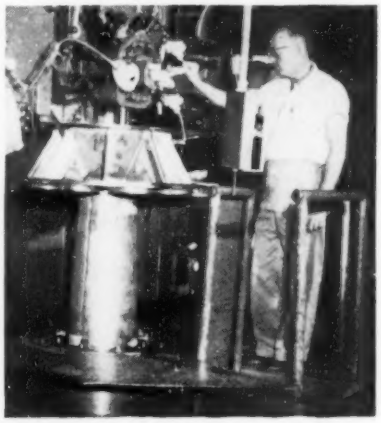


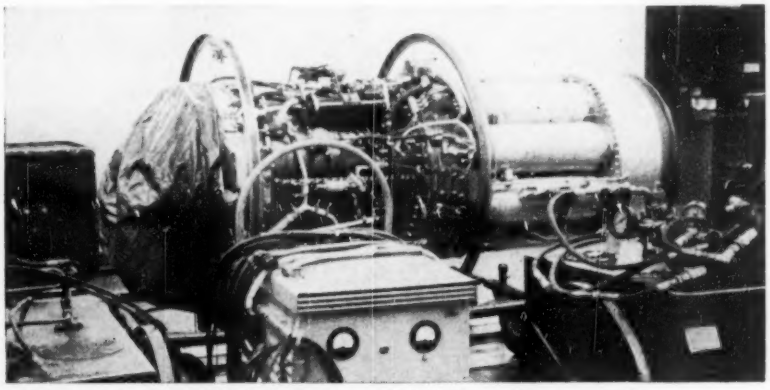
**CONVEYOR** transports long line of turbine wheels and shafts to balancing area.



**INSPECTION** of main accessory drive bearing cage before processing.



**AFT FRAME** is machined on flanged surface to correct misalignment.



**SETUP** for air, oil and fuel leak check on J35 before routing to test cell.

San Bernardino's and Middletown's materially reduced overhaul loads.

• **Reduced pipeline quantities** of jet engined for a specific mission.

• **Cut spare engine requirements** considerably. Spare parts, however, have increased because of the additional replacement parts required at base level for the field maintenance work.

• **Cost factors are favorable.** On one engine on which there had been considerable field experience, the average minor-repair cost per engine is about 1/10 that of the average overhaul cost per engine.

Average cost per flying hour with minor-repaired engines is about ¼ that of overhauled engines. This means that

**FINAL LINE** for J35 (left) and J47 (right), with modification line, right.

increased flying hour time as a result of minor repair has been obtained at ¼ the cost per hour of engines which have not had minor repairs.

• **Quick return to service** is possible with field maintenance—a matter of hours in an emergency, as compared to months required for complete overhaul, even with premium transportation.

• **Little investment in capital** equipment, such as machine tools, is involved for field maintenance. Mainly, tools required for the particular engine are special units. Welding equipment also is generally involved, but this type of equipment is portable and not included in the heavy equipment category.

• **Engine design changes** stemming from field maintenance experience have improved accessibility for field work and replacement.

Other design improvements also have been obtained because information is available faster from field maintenance than it would ordinarily be generated from engine overhaul bases.

The J57 engine has not yet been included in the field maintenance program, because not enough field experience has yet been generated with this powerplant. However, it is only a matter of a relatively short time before this engine too will be included in the program to lighten the load of overhaul bases.

## Tinker's Tools

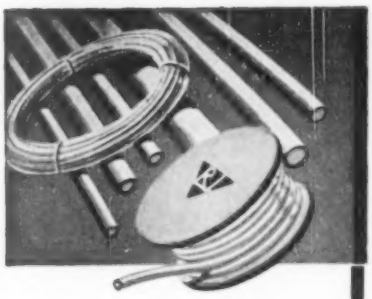
Tinker's overhaul activity is now running at about half capacity—about 15 engines per day per 8-hr. shift—plus some minor repair work for area support. For efficient operation of the overhaul facility, about 150 engines are required to be in process for the 15-engines-per-day rate.

▶ **How Long It Takes**—It requires about 14 days, on the average, for processing a J35 or a J47 from a repairable to a serviceable state. It is estimated that the generally bigger and more powerful J57 will require about twice the overhaul manhours, because it has two compressors, three turbine wheels, larger accessories.

With the overhaul facility processing the three engines—J35s, J47s, and J57s—peak capacity might be about 35 engines per day on an 8-hr. shift.

Tinker conducts a continuous training program for all phases of the engine overhaul activity. This includes cross-training in the various sections, as well as specialized training. Also included

**FIELD TEST CELL** is used for checking jets which have undergone minor repair.

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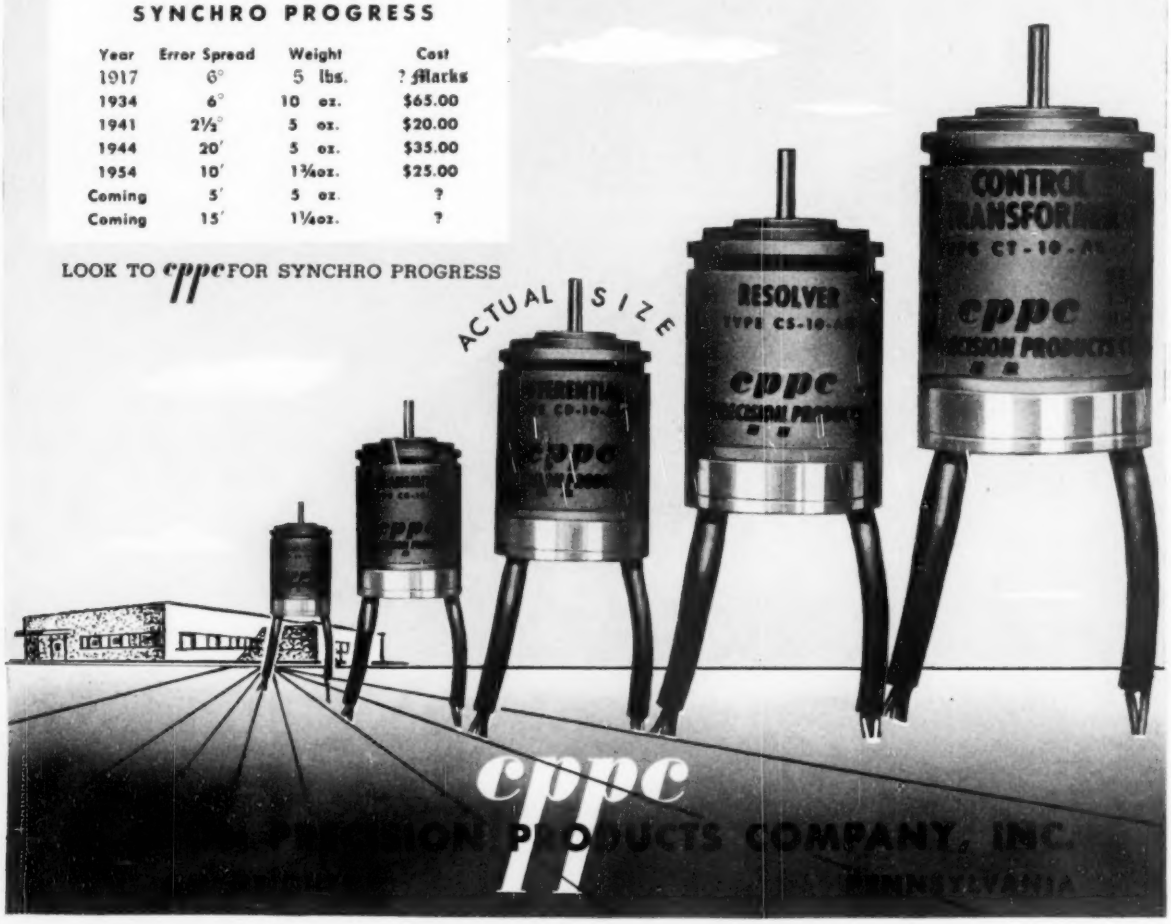
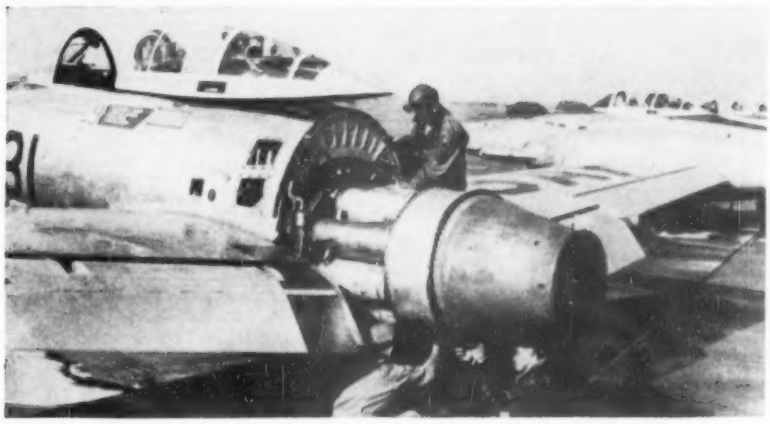
| 1944 | 20′ | 5 oz. | $35.00 |
| 1954 | 10′ | 1¾oz. | $25.00 |
| Coming | 5′ | 5 oz. | ? |
| Coming | 15′ | 1¼oz. | ? |

LOOK TO cppc FOR SYNCHRO PROGRESS





**FIELD REPAIR** is done on this F-84's J35 engine by AF mechanics in Japan.

in the training scheme are enlisted personnel concerned with field and minor repair, and foreign nationals under the Mutual Defense Assistance Program.

▶**In One End**—Engines are funneled into the overhaul facility from Tinker's local supply. They are taken in at one end of the building, removed from their shipping cans and installed on disassembly stands.

Accessories and all external parts are removed first and tagged with the engine serial number for bookkeeping and follow-up. These parts need not necessarily go back onto the same engine from which they came, whereas all other engine parts, also tagged by engine serial number, must be returned to their same basic engine.

Accessories are routed to an overhaul section in the same building as engine overhaul. However, testing of accessories is conducted in a separate building located close by the main building. The separate accessory test facility is required because of the hazardous conditions usually involved in accessory checks. The building is equipped with explosive-proof equipment.

After accessory tests, the units are delivered to the engine assembly line in complete sets per engine.

▶**Cleaning Procedure**—After disassembly (one line for J35, one for J47) of the engine components, they are first cleaned for inspection.

Cleaning is done on some parts with degreasing, on others with chemical soak, followed by hot water rinses. Some of the hot-section parts (combustion chambers, transition liners, nozzle diaphragms, etc.) require seed-blasting with wheat or rice hulls. In some cases, an acid dip is used for some hot-section parts which are heavily carbonized.

Monorails and electric hoists carry the parts through the washing and dip operations.

After cleaning, every part is given a complete inspection, visually and dimensionally. Checks are made with Zyglo, microscope, micrometer and shadowgraph.

Condemned parts are replaced with new parts from shop stock. "Reparable" tags are hung on reparable parts for processing through parts-repair sections. After repair, parts are again inspected dimensionally and visually.

Parts passing inspection bypass the parts rework section to an accumulation point ahead of subassembly, where they remain until repair or rework parts meet them for incorporation into the subassembly.

Movement of parts, generally, is accomplished with roller conveyor. There are approximately 25 mi. of this conveyor installation in the entire branch.

▶**Compressor Overhaul**—The compressor offers a good example of the detail involved in the overhaul scheme. The disks are disassembled from the shaft by freezing the shaft and heating the disks. Blades are then removed from the disks, condemned units are discarded and other blades are placed in racks and sent to heat-treat. After heat-treat, blades are reinstalled in their respective broaches in the same disks from which they came. Blade tips are then ground to insure conformity with the outside diameter of the compressor rotor assembly.

Wheels (disks plus blades) are then individually statically balanced and restacked to form the rotor.

The rotor is spin-tested in a vacuum chamber for overspeed condition 10% above maximum operating rpm. Zyglo checks are used to spot cracks which may have developed in the overspeed test.

The rotor assembly is then dynamically balanced to requirements.

Turbine blades and disks are put through a similar routine.

Nozzle diaphragm blades may be individually replaced or repaired by welding, depending upon condition.

▶**Crack Repair**—One of the major jobs on the aft frame of the jet engine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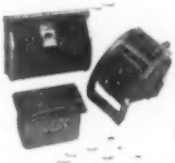
in customer choice of finishes are smartly styled, easy to clean, safe and non-jamming.



The appearance, condition and proper functioning of these checklist items, which most directly affect the comfort of your passenger, are important in creating a lasting, good impression. Be sure to favorably impress *your* "paying guest" simply and economically by replacing with TECO-built airline seats and accessories. TECO's exclusive new and improved features provide the kind of passenger comfort and relaxation that gets you repeat business!

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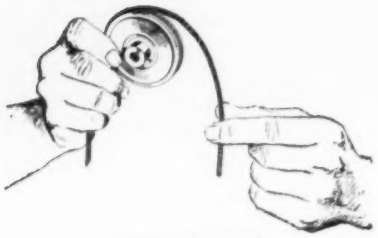


# A new key to Accuracy...

## IN JET ENGINE, MISSILE AND AIRCRAFT CONTROL LINKAGES

The unusual cable shown above is Teleflex—the unique "flexible rack" that is helping to solve mechanical motion problems in the control of jet engines, missiles and aircraft.

**Take an example in the jet engine field . . .**

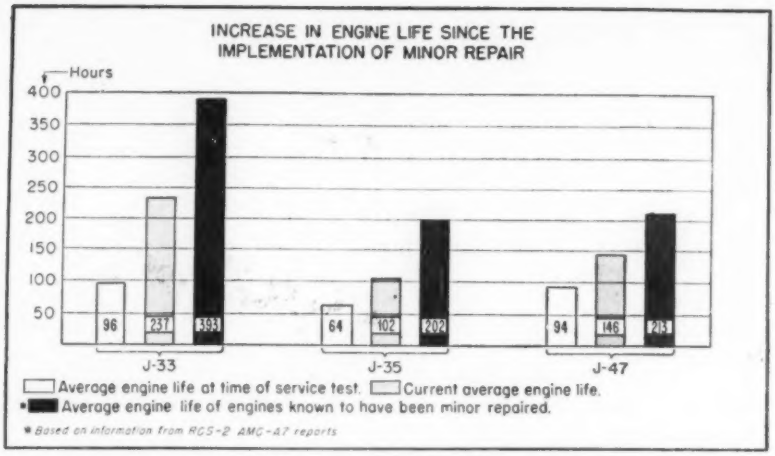
**PROBLEM:** A highly accurate mechanical feedback linkage is required to complete a servo system loop. One end of the system is exposed to a 350°F ambient temperature.

**SOLUTION:** A special control box was designed, with a hobbed wheel to engage the Teleflex cable. A spring-loading feature allows for a selection of spring loads up to 25 pounds, applied in either direction, depending on the individual mounting arrangement or system load. One system over 100 inches long, with 270° of bend, had only .022 inches of backlash. Under more favorable bend and length conditions, another system held backlash down to .005, using a similar control box.

Teleflex tubular conduit, routed along contours and around obstructions, guides the cable to remote locations, duplicating the motion at both ends of a system.

DESIGN ENGINEERS—For complete engineering data—send to Teleflex Incorporated, 125 S. Main St., N. Wales, Pa., for your copy of Catalog 400W.

TELEFLEX
MECHANICAL CONTROLS
LINKAGES MECHANISMS


results from cracks or distortion in its aft portion. This generally requires removal of an insert ring, welding of any cracks, and installation of a new ring by welding. The ring has to be machined to finished diameter.

Another job on this aft frame is realignment by machining of the forward flange.

Combustion chambers and transition liners are generally recoverable with welding if cracks are within established limits with respect to length, depth, and occurrence per unit area. Warpage is generally corrected by reforming.

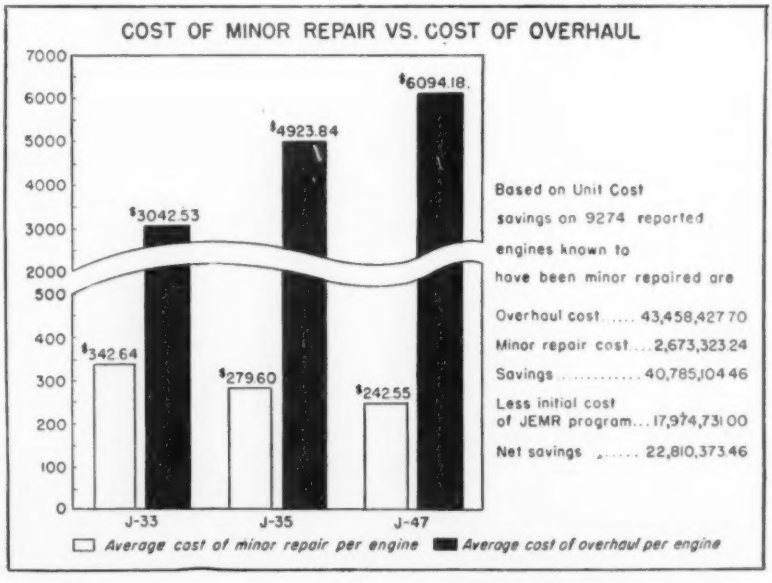
Stator case work generally consists of blending dents and welding of grooves and machining to match surrounding surfaces.

Alignment troubles are solved by bolting together the stator case halves, checking concentricity of attaching parts (midframe and forward frame), then machining the mounting flanges of the casing as required. Damaged studs and bushings on the stator case are major replacement items.

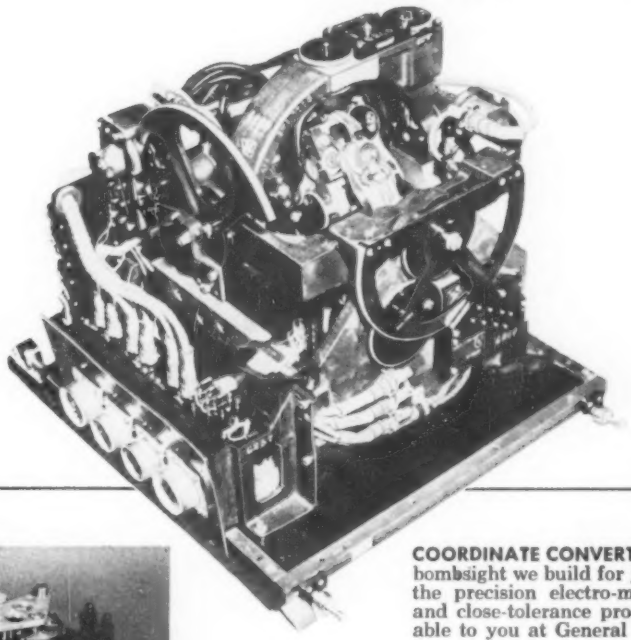
► **Together Again**—Roller conveyors bring all parts to a marshaling point just ahead of the assembly area. Subassembly work is so arranged that the resulting major units are the forward frame and its components, compressor assembly, midframe, aft frame, and turbine section.

These major subassemblies are built up on separate lines simultaneously and brought together at the final lines—two for the J35 and one for the J47. Here, these major subassemblies are brought together with parts such as the combustion chambers, accessories, plumbing and harnesses, to form the complete engine.

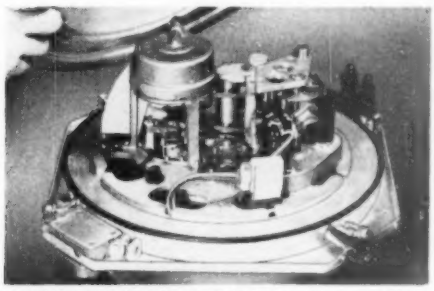
Completed engines are taken to the test cells for proving. Engines which pass the test requirements are placed in containers and processed for storage, then shipped to local supply for distribution. Engines which do not meet thrust or other requirements are forwarded to a "hospital line" for determination of deficiency or malfunction by specially trained personnel. ■ ■ ■



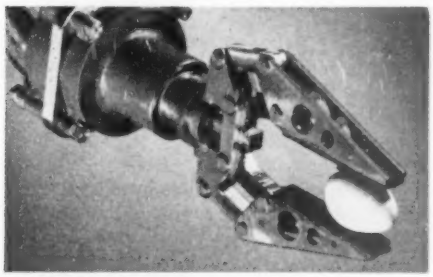
# PRECISION PRODUCTION OF ELECTRO-MECHANICAL COMPONENTS IN QUANTITY



**COORDINATE CONVERTER,** used in the Y-4 bombsight we build for jet bombers, illustrates the precision electro-mechanical engineering and close-tolerance production services available to you at General Mills.



**FLIGHT RECORDER** maintains continuous flight record of aircraft's altitude, airspeed, vertical acceleration, direction of flight and time. Record survives 2,000°F fire and 100G shock.



**MECHANICAL ARM** is an electrically powered, remotely controlled unit for handling materials and maintaining equipment in radioactive or otherwise dangerous areas. Standard model can lift 750 pounds or pick up an egg without cracking it.

**CLOSE-TOLERANCE** equipment is *mass-produced* at the Mechanical Division of General Mills. What's the secret? Just a rare combination of skills in research, design and development – topped with matchless production engineering and manufacturing capacity.

We have had wide experience in developing and producing high-precision assemblies for aircraft and missile systems, remotely controlled handling equipment, complex fire control systems, specialized precision instrumentation, electro-mechanical and electronic computers, industrial instrumentation and control.

**MAY WE HELP YOU** with any engineering or manufacturing problem you may have? . . . Just write: Mechanical Division, General Mills, Inc., 1620 Central Avenue, Minneapolis 13, Minn.

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**This is C.O.C.** When an operation is spread out across many acres, miles, or even states, and needs control from a single point, that's a job for "COC"—Centralized Operations Control.

When an operation is confined to just one building or area, but has many points where careful control must be exercised, that, too, is a job for "COC."

COC can open or close a switch or start a motor at an unattended station 500 miles from the control point, or it can indicate a danger or climatic condition at the end of a run-way.

There are varying degrees of COC.

Coming under this broad classification is the Hammarlund Multi-Gate® System which provides complete remote control and metering of such quantities as flow, temperature, pressure and voltages, as well as furnishing switching, warning alarms and various On-Off indications. And these operations can be performed over radio, microwave, wire or carrier.

Other Hammarlund systems are used to remotely control and meter or monitor unattended air/ground transmitter-receiver installations and radar stations located away from the tower, including monitoring of obstruction and beacon lighting.

Hammarlund "Fleet Control" and Selective Calling Units control the movements of radio-equipped vehicles efficiently and dependably.

Hammarlund "COC" is so broad that it can be adapted to handle practically any problem of remote supervisory control in the aviation field. For more information on COC write The Hammarlund Manufacturing Co., Inc., 460 West 34th Street, New York 1, New York. Ask for Bulletin CA-1.

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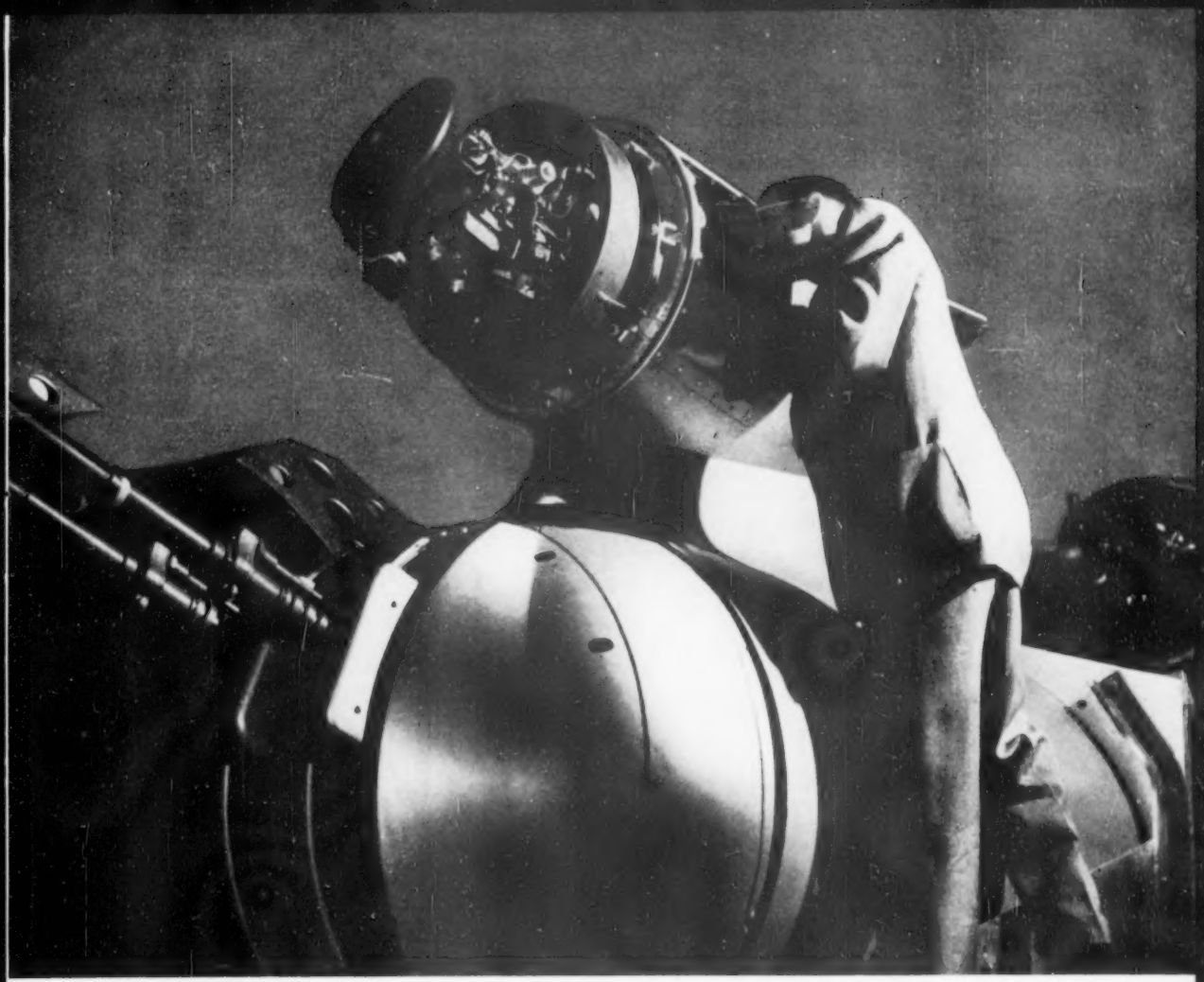

**RADAR-DIRECTED** tail turret, like this B-47 stinger developed by General Electric, provides defense for new jet bombers.

■ AVIONICS

# Avionics Puts 'War' in Warplanes

**Avionics makes warplanes out of airplanes. In the form of automatic radar-directed tail stingers, it protects long-range bombers beyond reach of their fighter cover. Avionics provides the seeing eye and computing brain which will enable our bombers to drop their nuclear bombs where they want them, day or night. Avionics gives our interceptors a fire control system which automatically directs them into position and fires their lethal air-to-air missiles, guided to the target by avionics.**

**In the form of automatic navigation devices, avionics guides bombers, fighters, and transports to their targets. As electronic countermeasures, avionics aims to puzzle and paralyze enemy missiles and radar. Avionics is also the unbilical cord that ties command posts to far-flung aircraft.**

**Avionic systems are getting bigger, more complex, with a heavier engineering content. This in turn has brought pressures on industry to make new components—the system building blocks—which are smaller, lighter, more reliable, able to operate at more extreme temperatures, under higher shock.**

**The avionics industry has expanded tremendously in the past five years to meet the challenge of solving these problems, some of which have been just on the ragged edge of possibility, an expansion that overshadows any other industry. It therefore is not surprising that competition is getting tougher.**

**However, for an industry that owes its growth to its ability to devise new tasks for avionics to perform, the challenge of competition should serve to stimulate the development of new roles for avionics to play, and thereby even greater industry expansion and markets.**

WHAT'S NEW AT BRISTOL...

# Need a rugged chopper-inverter?

## See Bristol's Syncroverter Switch*

Bristol Syncroverter Switches are non-resonant, wide-frequency, low noise-level, precision synchronous inverters or rectifiers, with two SPDT or one DPDT switching action.

A series of models is available, designed for optimum service under various operating conditions involving ambient temperatures of —55° to +100°C, and severe conditions of vibration and shock up to 500 cps and up to 50G. Standard contact rating: 0 to 3 volts, 2 ma resistive load. Voltages up to 150 v. can be handled under certain conditions.

EXCITATION REQUIREMENTS: 0.5 va or less with a-c up to 500 cycles. The Syncroverter will operate normally under sine wave, square wave, pulse, or special wave shape excitation currents; also applicable to plate circuit operation.

FREQUENCY: Operated on a-c of fixed or variable frequency: response up to 3500 cycles.

COIL DATA: Available with various coil impedances; also single or double coils for polar relay applications.

SERVICE LIFE: Life is dependent on operating frequency and loading. Typical rating: 1000 hours at 400 cycles.

Bristol Syncroverter Switches are available with either "make-before-break" or "break-before-make" switching action. They are reliable in the microvolt and microampere ranges. Cases are hermetically sealed.

If you have an application requiring a high-quality synchronous rectifier or inverter, write to The Bristol Company, 130 Bristol Rd., Waterbury 20, Conn., outlining your requirements. We can help you.

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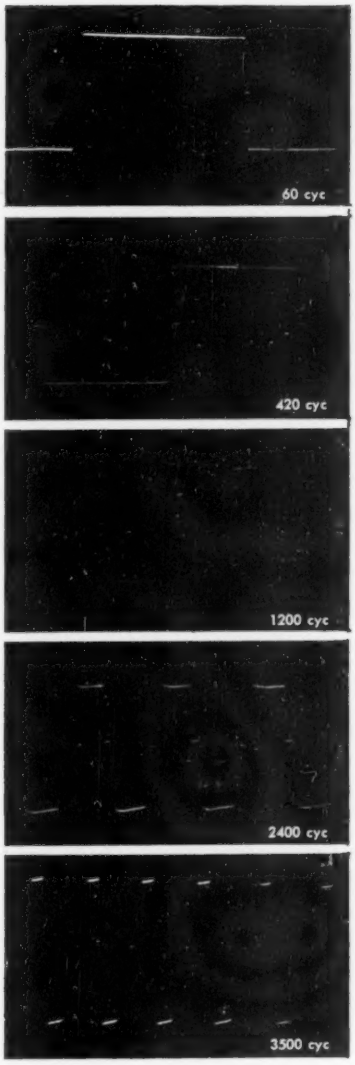
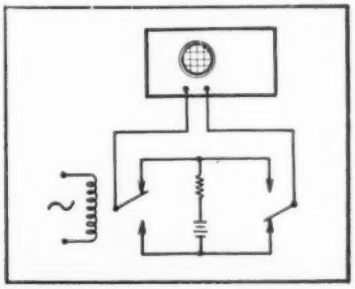



**OSCILLOSCOPE PATTERNS** photographed during DPDT switching of a typical Syncroverter at various frequencies in circuit shown.



**CIRCUIT** of Syncroverter and Oscilloscope during the above test.

4.22

BRISTOL

**FINE PRECISION INSTRUMENTS FOR OVER 60 YEARS**

# Competition Gets Keener in Avionics

By Philip Klass

**For the first time since 1941, the military avionics industry is operating in a buyer's market. This is a new experience for a large segment of the industry.**

**Today it is not unusual for 20 to 40 companies to submit proposals where previously only a couple would make bids, AMC officials report. In one recent competition for procurement of marker beacon receivers, 110 firms submitted proposals.**

Larger companies are now in bidding on jobs at which they formerly turned up their noses. Smaller companies, which previously were just component suppliers, are now after the larger complex systems jobs.

The result is that bidders are sharpening their pencils and quoted prices are coming down, AMC officials say. For instance, a reputable supplier selected in a recent procurement competition bid only $600 for supplying an item for which AMC previously paid $1,100.

▶ **Expanded Industry**—The present state of affairs is primarily due to the tremendous post-Korean expansion of the avionics industry. The expansion has come from three sources:

- **Newly formed companies,** of which there have been literally hundreds, particularly in the components field.
- **Companies seeking to diversify** by moving into the avionics field.
- **Old-line avionics suppliers,** expanding in order to try to maintain or increase their share of the market.

▶ **Stretchout Factor**—This situation unquestionably has been compounded by the stretchout in USAF's aircraft program which has hit procurement of airborne electronics somewhat. However, countering this is the increased buying of ground-based avionics for air defense and growing production of guided missiles, which have a very high avionic content.

The magnitude of missile avionics is not broken out of overall missile appropriations; this makes exact figures difficult to obtain. However, missile avionics should pick up some slack.

With Fiscal '54 only recently completed, and the allocation of Fiscal '55 funds still fluid, AMC officials are generally unwilling to say how avionics buying for the coming year will stack up against last year's procurement.

However, in two areas of avionic buying (totaling approximately $750 million last year) AMC officials hazarded a "guesstimate" to AVIATION WEEK that they would spend as much or slightly more than last year.

▶ **Capable Industry**—"We have developed a very capable avionics industry, from the standpoint of development capability and production capacity," according to Brig. Gen. Clyde H. Mitchell. Former chief of AMC's Procurement Division, Mitchell is now the Deputy Director/Production. Although AMC welcomes the competition which enables it to buy "more Air Force per dollar," Gen. Mitchell says it is studying the problem of maintaining a healthy industry, particularly its engineering capability.

One approach which AMC is exploring is to send some avionic equipment back to its manufacturer for overhaul. An example is the interceptor fire control systems, manufactured by Hughes Aircraft Co., which go back to Hughes for overhaul and modification. However this approach cannot be carried too far without jeopardizing AMC's own depot capability.

▶ **Tip for Industry**—Companies looking for new avionic fields to conquer might investigate possibilities in the countermeasures area.

"There must be tremendous growth and improvement in ECM," Gen. Mitchell says. However he points out that the amount of ECM production is relatively small. High-power, high-frequency tubes, such as Klystrons and traveling-wave tubes, may also prove a fertile field, Mitchell believes.

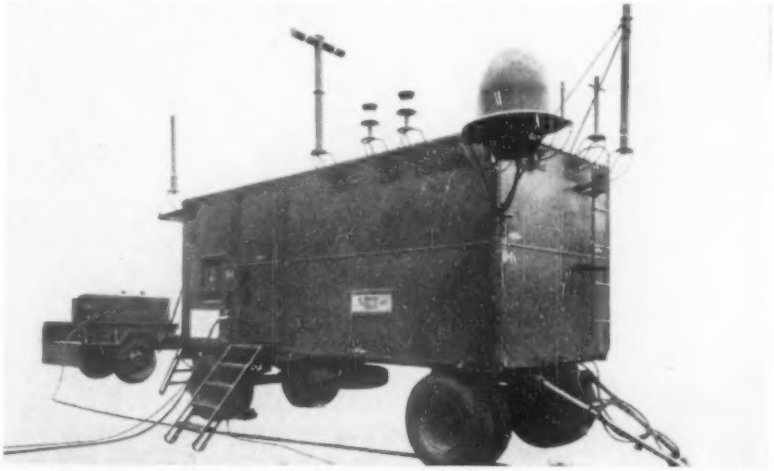
▶ **Broader ECM Base**—AMC is broadening its base of ECM suppliers, with many more companies showing an interest in the field, K. G. Springen told AVIATION WEEK. Springen is deputy chief of communications and photographic branch , in AMC's Aeronautical Equipment Division. This branch buys airborne radio, navigation equipment, countermeasures, IFF (identification friend or foe) and photographic equipment.

Although Springen would like to see even more suppliers in this vitally important field, he cautions that ECM equipment has a high engineering content and requires companies with "considerable depth."

The signs of increased competition first appeared about eight months ago, Springen reports. In addition to more bidders, and lower prices, he says that manufacturers are finding ways to increase the number of functions which their equipment can perform, but he declined to elaborate. "There's nothing like competition," Springen observed with a broad smile.

▶ **Trends**—Springen said his division is shying away from buying system components from separate manufacturers, in favor of complete systems contracts. He cited two examples: the AIC-10 integrated (high-fidelity) interphone system and the ARN-6 radio compass.

Wherever possible, service-test production runs are being made before a new equipment goes into full-scale production, Springen said. Using production tooling, a limited number of equipments are produced, then allocated to an operational base where performance can be closely monitored, bugs quickly discovered and corrected. The technique was first tried, with considerable success, on the new RCA



**AIRBORNE ECM,** which is tested against this electronic countermeasures trainer, is a field in which more industry effort is needed, AMC says.

AN/ARC-34 UHF transceiver. (AVIATION WEEK Aug. 26, p. 44).

AMC is following the same procedure on half a dozen new navaids and several new communications systems, Springen says. "Unfortunately we don't have the same opportunity to employ this technique with ECM, for obvious reasons," he adds.

▶ **Armament Competition Grows**—There is increased competition also in the fire control systems business, Lt. Col. F. F. Campbell, Chief of the armament procurement branch says. For instance, in a recent interceptor fire control system competition, three times as many manufacturers as usual requested the opportunity to submit proposals.

One of the companies, an old-timer in the avionic component and subsystems business now has its eye on more complex systems, and this is typical, Campbell reports. Two companies, originally set up as second sources on fire control systems, are now building up engineering capability with the view to tackling fire control system developments. AMC is not unhappy over this increased interest, and in some fire control areas, it wishes it had more.

However, modern bomber and interceptor fire control, bombing systems and gunsights have become so complex that AMC prefers to let prime contracts with complete system responsibility, and this requires a company with considerable engineering, manufacturing, and management depth.

▶ **More Private Financing**—More and more companies in the armament business are using their own funds to finance systems development instead of waiting for government-sponsored contracts, Campbell says. Col. E. H. Wilson, chief of the aeronautical equipment division, believes that the avionics industry ought to do a lot more development with its own funds if it wants to stay in the business.

There is considerably more company-financed development in the electrical equipment and instrument fields than in other avionics areas, Wilson believes. It is not unusual for an instrument manufacturer to anticipate AF needs and walk in with a new or improved instrument, developed at his own expense.

▶ **Look to Tech Reps**—Companies anxious to get a jump on competition could make better use of their technical representatives assigned to USAF bases, as a source for new ideas and products. "This is where requirements originate," Wilson points out.

By talking to pilots, flight crews, and base personnel, tech reps can find out what problems need solution, what new equipment is needed to enable the command to carry out its mission more effectively.

▶ **Added Incentive**—There is considerable incentive for a company to develop new products and systems. AMC's normal policy is to place initial production with the company which developed the equipment, Gen. Mitchell says. Later procurements may be on a low-bid basis, but even here the original contractor (with manufacturing experience under his belt) should be in a favorable position.

There are also signs of a possible trend to spell out required equipment reliability more specifically in contract specifications (for example: that X% of the equipments shall operate for 200 hours without any maintenance). This has been attempted for several newer equipments with mixed results. However it does provide an incentive for an avionic manufacturer to devote more effort to improving reliability, and that is what AMC wants.

Most of the new avionics equipment going into service now and in the near future has topnotch performance—when it works, Gen. Mitchell says. The industry's greatest challenge is to make equipment reliability match its performance. This, Gen. Mitchell believes, is a joint problem for the equipment manufacturer and the component supplier. ■ ■ ■

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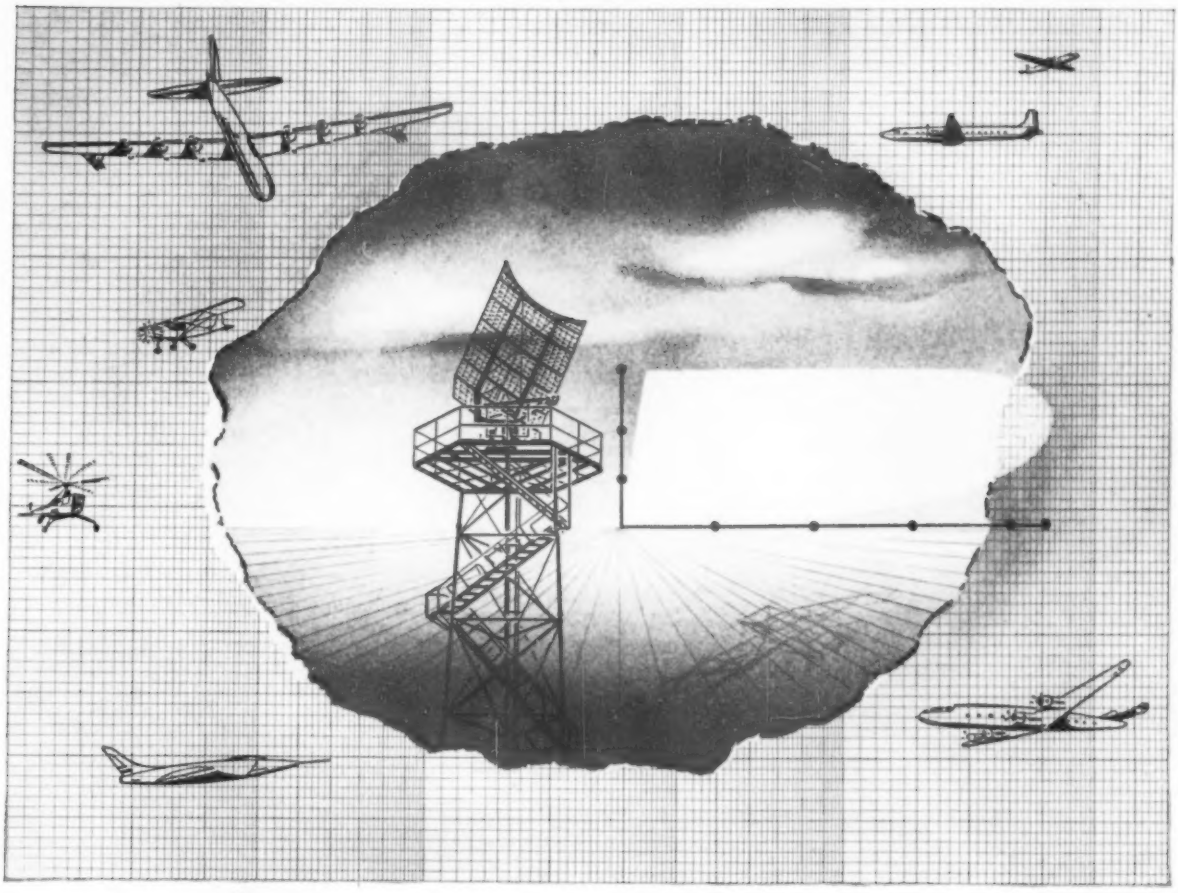
NEW HORIZONS IN ENGINEERING



# Airport "Traffic Cop"

General Electric developed this unique radar system to track, position and control plane traffic with maximum safety.

It provides many advantages over conventional systems. The special shape of the antenna radiates a beam 12,000 ft. vertically and from 30 to 60 miles horizontally, providing control of all planes in proximity to the airport. Within the pattern of this beam all aircraft are easily detected.

The Special Products Division of I-T-E was asked by General Electric to undertake the production, design and fabrication of this antenna to rigid tolerances. Although 10 feet wide and 12 feet high, the finished product deflected only ¼ inch in actual use when covered with ice and subjected to a 90 knot wind.

This is another of the many ways in which I-T-E technology and specialized fabricating background helps solve production problems for industry. Special Products has an experience in a wide variety of fields. Their engineers might have the solution to your problem.

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SP 10.4

# Gentile Keeps AF Avionics Operational

**Dayton—This year more than two million avionic items, ranging from a box of resistors to an airborne radar, will make the trip down a mile-long overhead conveyor here at Gentile AF Depot on their way into one of four large warehouses or out to some far-flung base. Every day an average of 7,000 shipments leave Gentile at an annual rate approaching $150 million.**

Under command of Col. Leslie Mulzer, this depot is responsible for buying all tubes, resistors, capacitors, transformers, relays, and other vital bits and pieces needed to put ailing USAF avionic equipment, both airborne and ground-based, back into operation. The depot also buys all AF test equipment, both electrical and mechanical. Total procurement last year ran around $200 million.

Airborne radio, navigation, countermeasures, IFF, and radar equipment is bought by Gentile following initial support procurement (first 18 months) which is handled by AMC at Wright-Patterson AF Base. This arrangement is designed to facilitate coordination of this GFAE equipment with airframes in the early phases of an aircraft program.

▶ **More Than Supply**—Important as is its supply mission, Gentile has other roles to play in the AMC set-up, including:

- **Overhaul of airborne** radio, radar (except fire control), navigation and countermeasures equipment.
- **Operate a complete radio** crystal-manufacturing facility to handle emergency and special requests.
- **Provide a small AF** "Bureau of Standards," with portable calibration standards for other AMC depots and AMAs.
- **Construct specialized** portable maintenance facilities.

Approximately 3,200 are currently employed at Gentile, of whom approximately 1,800 are in supply, 800 in maintenance, and 100 in procurement. The balance are supporting functions.

▶ **Housekeeper's Delight**—Despite the fact that Gentile's warehouses are bulging with 154,000 different items, valued at $340 million, Col. Mulzer says that the depot's card file system can pinpoint the exact location of any item on the first try "99% of the time." A walk through the warehouses (where Col. Mulzer knows many of the employes by first name) provides convincing evidence. Material is stored with an orderliness and neatness to satisfy the most discriminating housekeeper.

Gentile is taking some of the bulge out of its warehouses with a program to dispose of $43-million (original cost) worth of surplus and obsoleted equipment, some of it dating back prior to World War II. This program, which may save the taxpayer several million dollars, has already vacated 75,000 sq. ft. of storage space and another 150,000 sq. ft. is expected when the program is completed this fall.

As a result, Gentile will be able to get along, at least for the present, without constructing a new $5-million warehouse which had already been budgeted and approved.

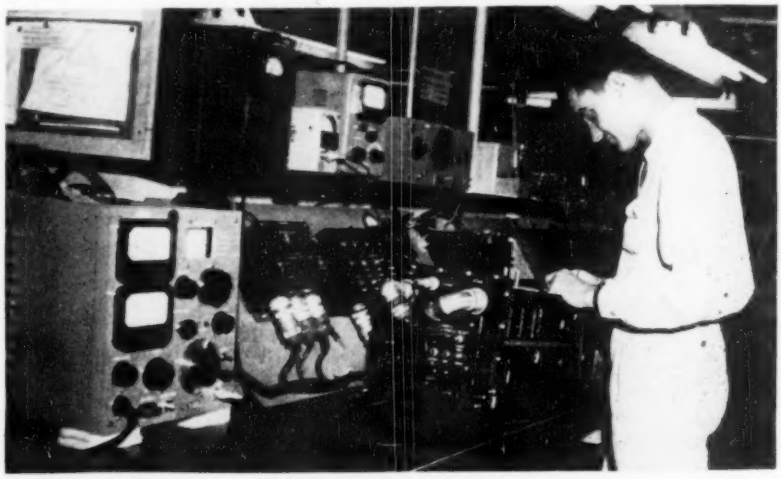
▶ **Surplus Disposal**—Careful checks have been set up to make sure that the depot does not dispose of usable material. If the item is still in limited use, the supply people set aside enough to meet anticipated needs for the next five years. If the item is obsolete, a committee determines whether its reclamation costs would exceed its value.

Other military and government services get first crack at disposable surplus items, followed by educational institutions. Then the surplus goes on public sale, usually sealed bid, in small lots.

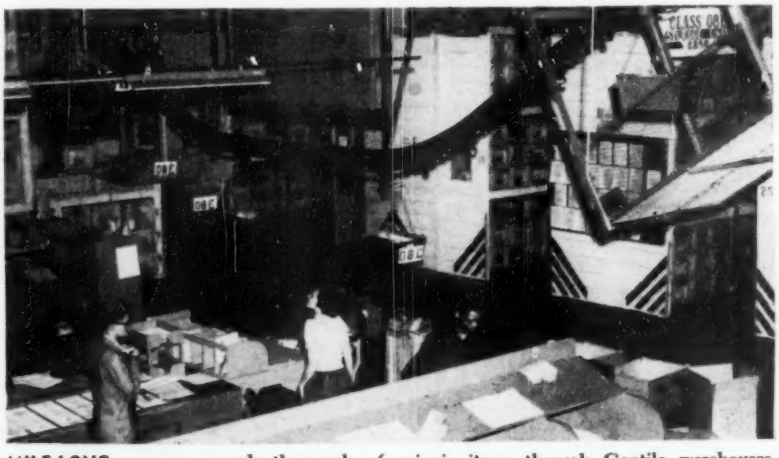
Mulzer pointed out one group of obsolete generator test stands, some in bad condition, which brought $160 apiece, against an original cost of $1,000 more than 10 years ago.

A few items, like tool kits, are equitably priced and sold individually in a small retail-type outlet on the base. Any equipment such as radar, which would be of strategic value in the wrong hands, is completely crushed in a hydraulic press and sold as scrap.

▶ **Holding Down Surplus**—Gentile does not intend to let another large hoard of over-age surplus build up to consume valuable storage area (which costs $10/sq. ft. per year) and require time-con-



**OVERHAUL SHOPS** restore 8-9,000 equipments to good-as-new condition monthly.



**MILE-LONG** conveyor speeds thousands of avionic items through Gentile warehouses.

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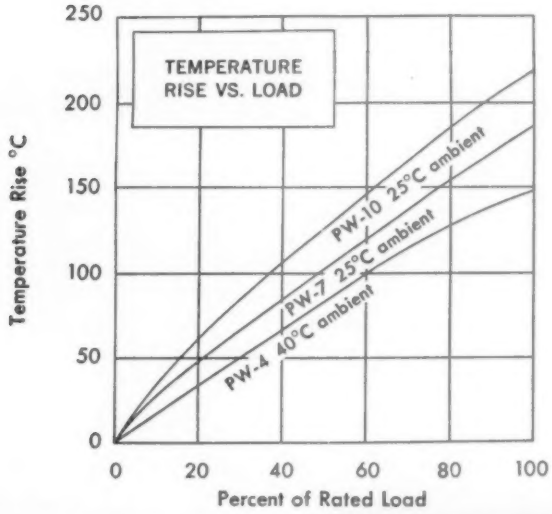
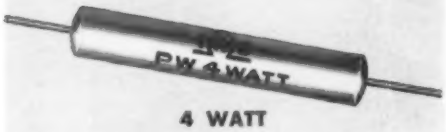
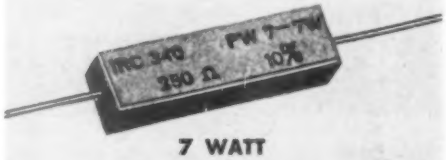
IRC's new power wire wounds are lower cost per watt than any other power type. At 4, 7 and 10 watts, they offer savings of several cents each in any application requiring compact, low cost, efficient power resistors. Types PW-4, PW-7 and PW-10 resistors assure safe operation in circuits where stability and low wattage dissipation are needed.




**4 WATT**

**Type PW-4 allows safe operation with hot-spot temperatures up to 165°C. Fully insulated housing will not burn or support combustion.**

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**Types PW-7 and PW-10 allow safe operation with hot-spot temperatures up to 275°C.**

**10 WATT**

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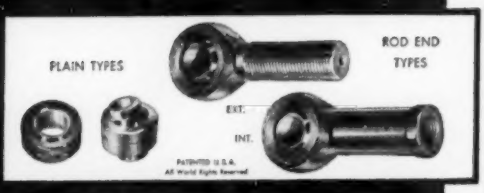


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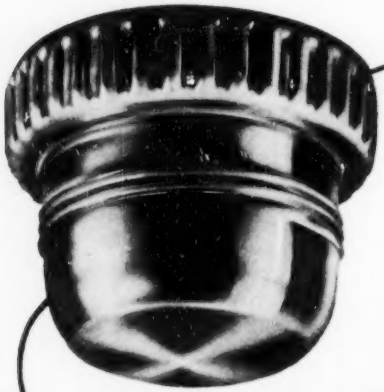

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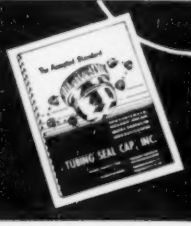


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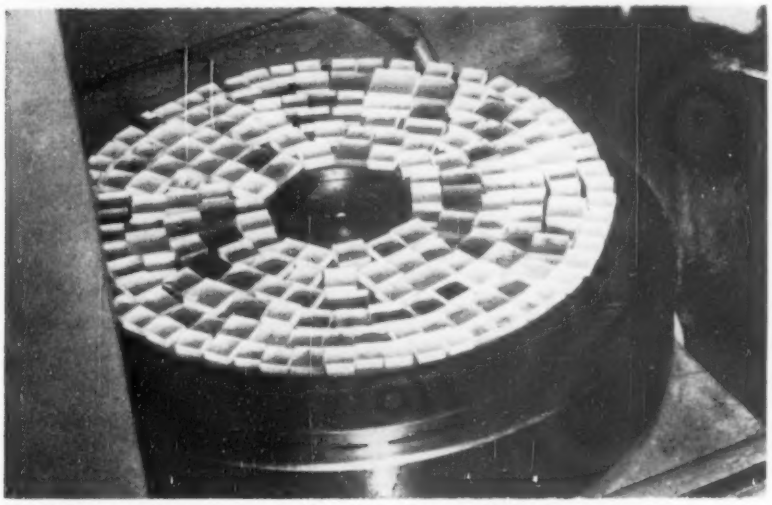
**GENTILE CRYSTAL SHOP** has complete facilities for making radio crystals for special emergency requests. Quartz stock (arrow) is first sliced into thin blanks.



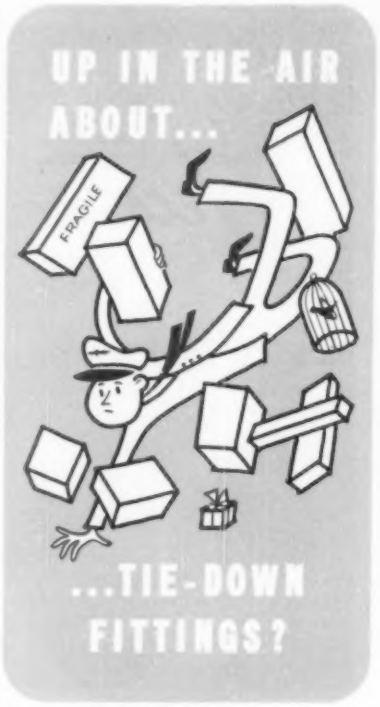
**PRECISION LAPPING** assures crystal is flat to 1 or 2 millionths of an inch.

suming inventorying twice a year. Equipment returned to the depot for overhaul is opened, inspected and, where appropriate, immediately tagged as disposable surplus and readied for prompt disposal.

► **Speedy Handling**—Ninety-four percent of all requisitions are filled and the material delivered to the depot's shipping department within five days after the order is received, Col. N. J. Folwell, chief of the Supply and Services Directorate told AVIATION WEEK. If an order comes in with a No. 1 (top) priority, the material will be in the shipping department's hands within four hours, Folwell says.

The Supply and Services Directorate has the responsibility for receiving, storing, handling, packaging and shipping all material coming into or leaving

**IN FINAL TEST,** crystals must meet same standards as those made by industry.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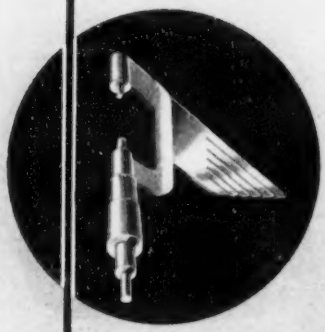

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**SPECIAL TEST EQUIPMENT,** such as this trailer for maintaining and . . .

**OVERHAULING** computing gunsights, is designed and constructed at Gentile AFD.

Gentile. Disposal of surplus and obsolete material is also part of its task. One of this directorate's most important functions is to establish procurement requirements for each of the 124,000 different items for which Gentile has prime responsibility.

Although the directorate makes wide use of presently available punch-card machine techniques for its supply and requirements activities, it stands to gain much from the world-wide high-speed electronic data processing system now in the planning stages at AMC headquarters. Col. Folwell is closely following the work of this group and Gentile may serve as a guinea pig to prove out electrodata techniques for depot use.

► **Tying Loose Ends**—In any supply operation of this type, which handles a hundred thousand related but individual items, someone has to tie up possible loose ends, and that is the role of the Logistics Support Office of the directorate.

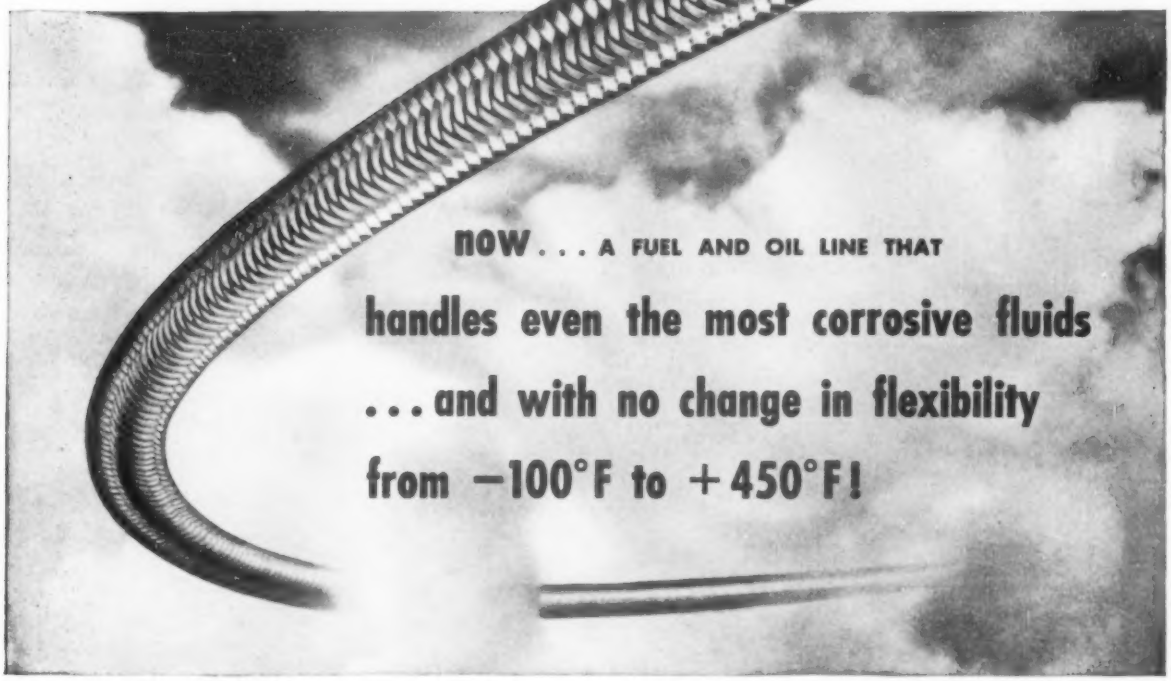
One group in this office has individuals assigned on an aircraft-type basis to make sure that all electrical and hydraulic ground-support test equipment for that particular airplane is available. Another group has product specialists on individual airborne avionic systems, to follow field modification and retrofit programs, make sure that needed parts and supplies are available.

A third group in this office controls the scheduling of parts needed for overhaul of avionic equipments in the depot's own shops. A fourth group monitors AF supply directives which call for a variety of material to be readied, frequently in one location at a specific time, for a special project.

Packaging problems occasionally prove a challenge in this business. For example, a radar magnetron cannot be shipped by air in an ordinary container lest its strong magnetic field disturb the plane's compass. To provide necessary shielding, magnetrons slated for air transport are wrapped in six layers of grain-oriented steel foil.

► **Overhaul Time Standards**—AMC is attempting to establish time standards in all its depots for each of its overhaul and maintenance operations. Objective is to enable a depot better to control

# first aircraft hose using TEFLON*




HERE's the new Fluoroflex†-T hose assembly you've been hearing about—an amazing hose development that sets a new standard of service life.

This line has everything needed to beat the tough new jet engine plumbing problems. It has Fluoroflex-T (Teflon compound) tube, which is wholly unaffected by JP-4 fuel, aromatic fuels, MIL-L-7808 synthetic lubricating oils, and petroleum oils; and which permits a permanent fluid-seal at the fittings. It has compression type fittings that won't blow off (but can be readily field assembled) . . . and also a highly resistant stainless steel armor for 1000 psi working pressures for all hose sizes.

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*The Verson-Wheelon Bulletin explains the simple operation of the Verson-Wheelon Press and shows examples of the work it performs. Typical specifications are also given. It is available on request.*

Yes, this Verson-Wheelon Press has a capacity equivalent to a 21,000 ton rubber pad forming press. However, it does a better, more complete forming job than the rubber pad press; yet its cost is only a fraction of that of the conventional press.

The Verson-Wheelon Press illustrated operates at 5,000 psi. Its twin feeding tables are each 50″ x 168″ to handle long channels for a leading aircraft manufacturer.

If you are now doing or contemplating rubber pad forming, you should consider a Verson-Wheelon Press before you buy. Compare the price and compare the work—it's the best way to convince yourself of the economy of Verson-Wheelon forming. The bulletin described at the left gives full information. Write for your copy, today.

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its operations and to be in a position to determine whether it can take on new programs with existing facilities and manpower.

Time standards, a familiar practice in industry, are difficult to establish for overhaul operations where the runs are small and equipments come back in a variety of conditions. When the equipment involved is avionic, establishing time standards is even harder.

How can you predict how long it will take to fix an airborne radar, for instance, when you do not know how long it will take you to find the source of trouble, the most time-consuming element?

Despite this obstacle, Gentile's Maintenance Engineering Directorate and an outside firm of consulting engineers are attempting to work out uniform overhaul time standards for various types of avionic equipment. Although it may take a couple years, Col. E. J. Hamilton, head of maintenance engineering at Gentile, believes that realistic and useful standards can be set.

The use of standardized trouble-shooting procedures would be one way to achieve greater uniformity in overhaul time between different technicians, Hamilton says. However, he adds that technicians like to follow their own, often intuitive, fault-finding procedures.

**BATTERED RADAR** antenna shows how some equipment is returned for repair.

▶ **Battered and Beaten**—When avionic equipment comes back from the field, it may be battered and beaten.

However, when equipment leaves Maintenance Engineering's shops, its performance will be as good or better than when it originally left the factory, Hamilton says. Performance may be slightly better because of Gentile's job-shop environment which allows technicians an opportunity to tune up the set for optimum performance.

Gentile's avionics technicians are organized in groups of 15-19 under a supervisor. Each group specializes in a particular type of equipment; i. e. communications, navigation, countermeasures, radar, etc. However, individual technicians (mostly men, with a sprinkling of women) are rotated and advanced to more complex equipments to give them broader backgrounds and enhance their skills.

An average of 8,500 to 9,000 major components go through overhaul monthly here at Gentile, making it a large-scale operation by any standards. For this reason, the latest production control techniques and visual display charts of job progress are used to assure an orderly operation.

▶ **Short-Order Crystal Facility**—"If we don't stock it, we'll make it" might very well be Gentile's motto on radio crystals. The Maintenance Engineering directorate operates a complete crystal manufacturing and testing facility capable of turning out practically any kind of crystal in 24-48 hours. Some idea of its capacity can be gained from the fact that during the war it turned out 10% of the radio crystals produced in this country, according to W. L. Horton, civilian head of Maintenance Engineering.

Today it is operating way below capacity, used only for small orders of


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W-Type Bendix* Connectors also incorporate standard Scinflex resilient inserts in established AN contact arrangements.

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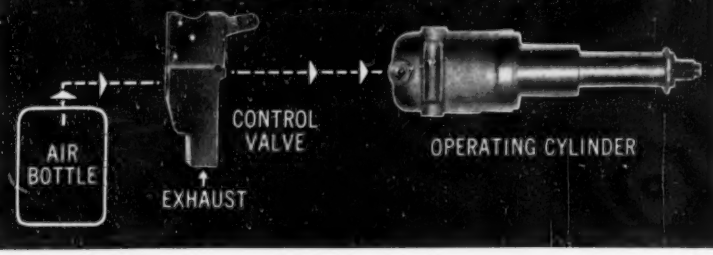
# How to use pneumatics in aircraft

## FOR ONE SHOT EMERGENCY POWER




For one-shot operations like canopy removal or pilot ejection, you can get a ready source of power with high-pressure air. And you'll save weight and space in the bargain.

The diagram above illustrates the simplicity of the system. All that's needed is a bottle of air, a Westinghouse Control Valve to regulate the flow of air, and a Westinghouse Cylinder to supply the power. These devices are small and lightweight, and have been proved rugged and dependable in actual aircraft service. You can use them at pressures up to 3,000 psi. They operate perfectly at any temperature from 65° below zero to 160° above!

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**FLETCHER**

certainly builds good tanks fast

PASADENA, CALIFORNIA DAYTON, OHIO WASHINGTON, D. C.




special crystals which are not ordinarily stocked, or for emergency requests where stock is depleted. In these specialized areas, Horton says the crystal section can produce them cheaper than commercial manufacturers who are set up for large-scale production.

Gentile starts with rough quartz crystal stock, cuts the wafers to an accuracy of 1-1½ minutes of arc, laps them to a flatness of 1 or 2 millionths inch, mounts calibrates, and tests them. Gentile's crystals normally exhibit a frequency tolerance of 0.0005% over their operating temperature range, Horton reports.

▶ **Standards Bureau**—Gentile's Maintenance Engineering Directorate operates a precision Standards Laboratory which serves to calibrate electrical, electronic, and tool and gage measurement devices at all AF depots and AMAs.

The permanent standards here, which are regularly checked against those at the National Bureau of Standards, are used to calibrate "transfer standards" which are then flown to the various depots to check base standards. Present plans call for a C-47 to be outfitted as a flying standards lab, with shock-mounted fixtures to hold Gentile's transfer standards.

To be sure that calibration has not changed in transit, the transfer standards are checked against the permanent ones when returned to Gentile.

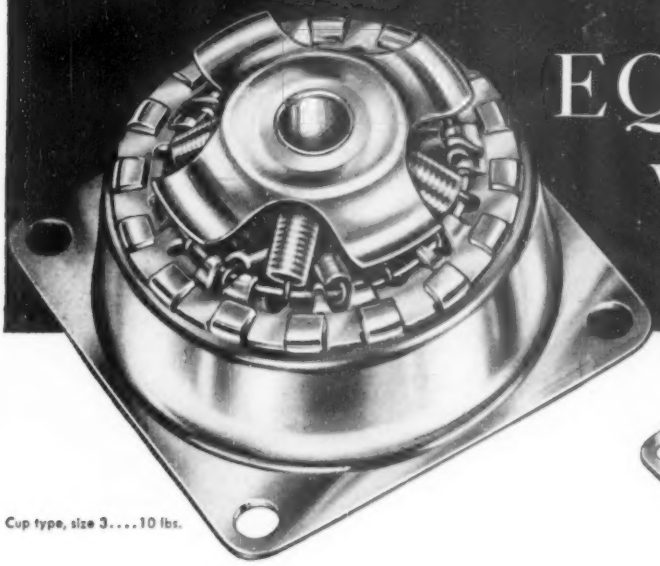
▶ **Special Test Equipment**—Because of its technical capability, Gentile's Maintenance Engineering group is frequently called upon to make up specialized test vehicles. For example, an interceptor fire control system tester was mounted in a console atop a jeep. The jeep can be driven alongside the plane enabling the maintenance man in the cockpit to reach out and operate tester controls while at the same time observing the cockpit radar scope.

Another Gentile product is a maintenance-overhaul shop for computing gunsights. The shop is mounted in a portable trailer van which can be airlifted in a C-124.

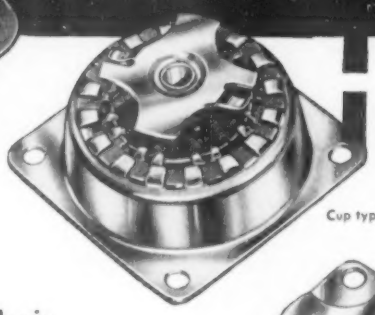
▶ **New Home**—By the end of the year, Maintenance Engineering expects to moves its shops to a new 200,000-sq. ft. building adjoining another 240,000-sq. ft. warehouse for storing repairable material returned for overhaul. This arrangement will simplify material-handling problems.

Gentile's Directorate of Procurement and Production, headed by Maj. M. K. Andresen, expects its Fiscal '55 buying roughly to equal the $200 million obligated last year. This procurement, made almost exclusively on a fixed-price basis, was distributed among more than 1,000 companies. Approximately 5,000-6,000 contract awards are made annually, Andresen indicates. ■ ■ ■

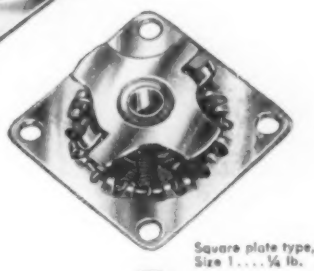
# Ucinite EQUIFLEX vibration isolators



Cup type, size 3....10 lbs.



Cup type, size 1....½ lb.



Square plate type, Size 1....¼ lb.

Standard Equiflex mountings come in two basic types...the Square Plate and the Circular Cup. Both types are available in three different sizes . . . size 1 for light loads or small equipment, size 2 for medium loads or medium duty equipment, size 3 for heavy loads or heavy duty equipment.

Equiflex mountings withstand 100 hour salt spray tests, take 15G shocks without damage and will keep equipment captive up to 30Gs. Extra-damped mountings are available in which each multiple coil spring is shrouded with polyethylene or Teflon tubing.

Equiflex vibration isolators can be supplied to cover load ranges from ¼ to 35 lbs.

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- Wide temperature range.
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- Can be loaded in any direction or position.
- Absence of drift or permanent set.
- Equiflex action or 1:1 ratio of radial and axial spring rates.
- Integral single unit assembly with safety washers included and attached.

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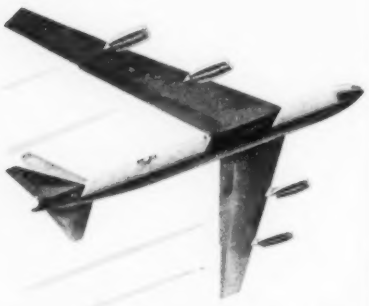

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# Better Management Cuts Personnel

One of Air Materiel Command's greatest resources is people.

A part of the mission statement of the Directorate of Personnel and Support Operations, Headquarters AMC, states briefly that this directorate "exercises staff supervision over all matters pertaining to personnel."

When the average person thinks of this phrase, he thinks, "This is the organization that assigns personnel to the various positions required to accomplish the job of the Air Materiel Command."

But in reality, this is only one facet of its many sided responsibility. In the first place, it refers to a total of 160,000 military and civilian personnel—149,000 civilians, 8,000 airmen and 3,000 officers, scattered throughout the United States and overseas.

The Commander, AMC, through the Director of Personnel and Support Operations, is vitally interested in the welfare and development of each of these individuals as a means of insuring that the Air Materiel Command receives the maximum productivity from every man and woman employed.

► **More Work, Less People**—The major problem with which the Commander is faced, personnel-wise, is how to accomplish the ever-increasing workload of the Command with the continuing decrease of personnel who come under his jurisdiction.

Early in 1953 the Department of Defense fixed AMC's civilian manpower ceilings at a number equal to the 170,000 civilians on the payroll as of Jan. 31, 1953. By June 30, 1953, additional directives from Headquarters, USAF, cut this ceiling by another 8,700.

Then, through management improvements in depot supply, maintenance and support operations, AMC effected a further cut of 10,000 civilian personnel in the last six months of 1953 and made an additional 4,000 cut in the early part of 1954. Further aiding in this reduction was the reorganization which eliminated seven subordinate headquarters.

This all adds up to an over-all personnel reduction since January 1953 of approximately 20,000 civilian personnel, nearly 2,000 officers and over 2,000 airmen—this during a period in which USAF was building toward the 137-wing program. Obviously, an AMC program consisting of combined assets totaling an estimated $30 billion could not have been administered without strong management ingenuity.

► **Efficiency Programs**—How did AMC balance this increased workload with the decrease in manpower? For the most part, management relied on careful planning integrated with this series of personnel programs:

• **Career development,** similar to that which has received widespread interest throughout private industry, was programmed in 1953 and became effective early in 1954. It will be extended throughout all AMC installations by the end of this year.

This program is designed to increase the efficiency of personnel, and groom selected employes for higher positions of responsibility. This will be accomplished by a system of job rotation, individual appraisals and training programs to meet the development needs of each individual.

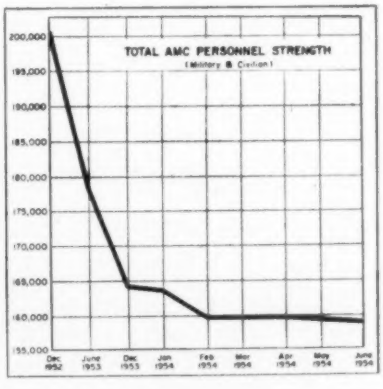
• **Executive development program,** for AMC headquarters and AMAs, calls for prominent speakers to address executive personnel at bi-weekly luncheons. Plans are to incorporate the program into all echelons.

• **Suggestions and awards program** has paid big dividends. Through "idea bonuses," AMC reduced operating costs approximately $6,389,000 in 1953. More than 6,500 suggestions were adopted, and employes were paid $250,000.

Also in 1953, AMC cut costs by $1,500,000 as a result of increased emphasis on the control of sick absenteeism. The figure was determined through a study of the sick leave absence for the five-year period preceding AMC's management plan to control such absenteeism.

Big item has been increased ability to keep qualified personnel. Through concentrating on a number of personnel management programs and techniques, the Command has been able to reduce its "quit rate" to such an extent that it is now 40% less than the average industrial rate computed for the past six months.

• **Off-duty education program also** has been extremely successful during this



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about G-E CLASS 500 silicone rubber for low-temperature applications! Compounds are available in a variety of hardnesses, or special compounds can be made to your exact specifications from G-E silicone gums. For the names of experienced fabricators and for complete technical data, just send the coupon!

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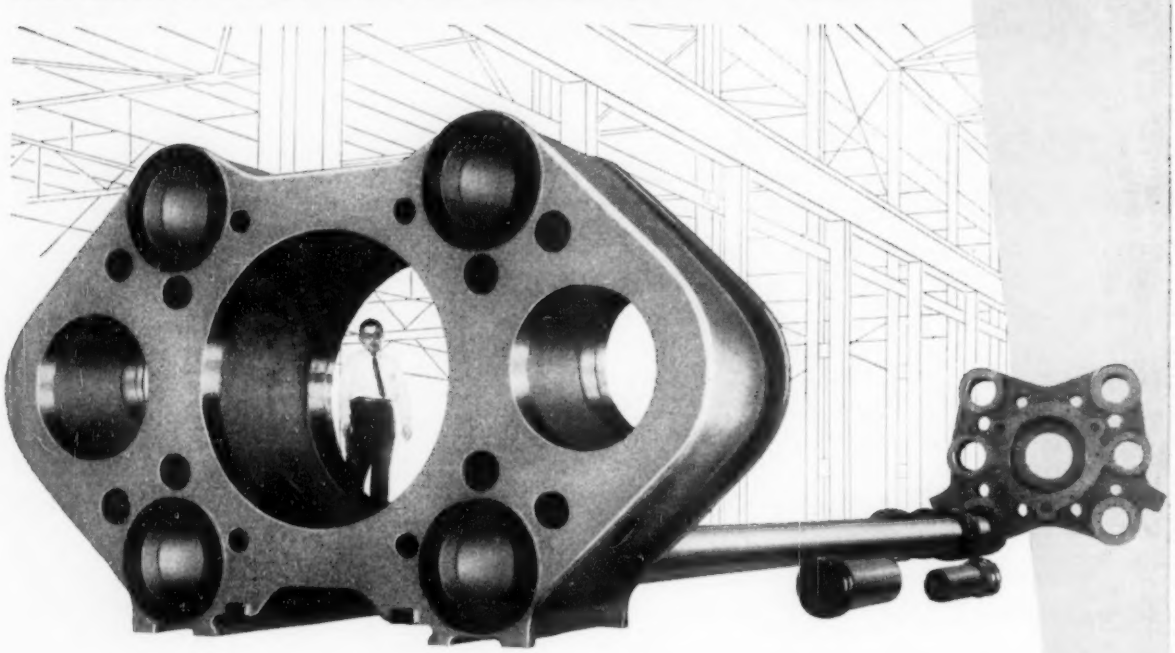
# WORLD'S LARGEST Horizontal Steel EXTRUSION PRESS

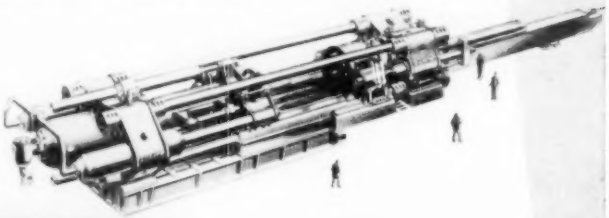


## Joint U.S.A.F. Air Materiel Command — Curtiss-Wright Development Designed to Speed U.S. Industrial Production

Completed on schedule after four years of intensive teamwork development, the world's largest horizontal steel extrusion press is now being installed at the Metals Processing Division of Curtiss-Wright at Buffalo, N. Y.

This 12,000-ton press, designed and built by the Loewy Construction Company, is capable of extruding 9,000 lb. billets to 40 foot lengths. It can handle steels, titanium, or non-ferrous alloys, and is supported by full supplementary processing equipment and a die shop — plus a staff of experienced metallurgists and product design engineers.

Created as part of the government's defense program, this giant press will, by January 1, 1955, be at the service of American industry. Design and industrial engineers are invited to consult with Curtiss-Wright on availability of this new tool in solving problems and advancing production goals beyond the capacities of conventional equipment.



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period, providing both academic and vocational education through classroom instruction or correspondence courses in subjects normally taught in civilian academic and vocational institutions.

During the average week in 1953, more than 1,400 officers and 3,500 airmen were taking part in this program, and 1954 has already shown an increase in the number of people who are participating.

Safe working conditions too have been of utmost concern to management. This concern has been instilled down through the chain of command so that it is now four times safer to work in an AMC installation than in an average industrial plant. The National Safety Council has, for the second consecutive year, recognized this accomplishment by conferring upon the command its highest award, the "Award of Honor for Outstanding Ground Safety Performance."

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Complete aircraft.
Propellers and parts.
Wheels, brakes, skis, floats and parts.
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**HAS IT!**

This new Klixon push-pull circuit breaker successfully ruptures circuits adjusted for 6000 amperes at 30 volts DC and 3500 amperes at 120 volts, 400 cps AC.

It has been especially designed for manual switching operation, and can be cycled at least 10,000 times without significant change in calibration. Each D6752-2 is individually "ultimate trip" calibrated and X-ray inspected to insure dependable operation.

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The Klixon D6752-2 has Air Force engineering approval in ratings of 5 through 35 amperes with authorized use of #25017.

Write for data describing the D6752-2 and other Klixon *performance-proved* circuit breakers.

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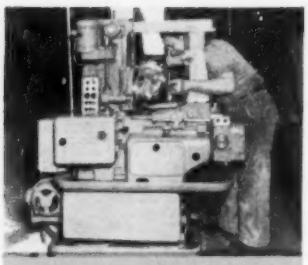
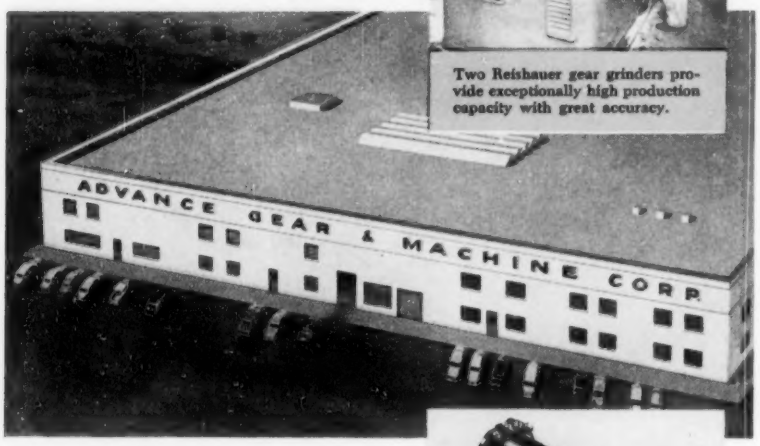


Pfauter Super Precision hobbing machine . . . one of the recent additions to ADVANCE facilities.

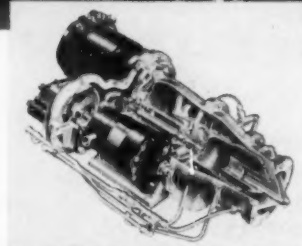
Two Reishauer gear grinders provide exceptionally high production capacity with great accuracy.




When gear problems are tough, that is the time to look to ADVANCE. Here, complete facilities assure the finest precision gear production that will meet exacting aircraft specifications. Perfect tolerances, maximum strength, precision performance are a part of ADVANCE production. Years of engineering and design experience enable ADVANCE to provide real assistance on every type of gear problem.

***A single gear or a complete assembly***

Whether your need is for a single gear, gear products or a complete gear assembly, you will find ADVANCE qualified in every way to help you. Write or phone today for our new brochure, "Gears and Gear Products."



This integral part of the mechanism of a 40 HP turbine driven unit is typical of the many gear assemblies produced for the aircraft industry.

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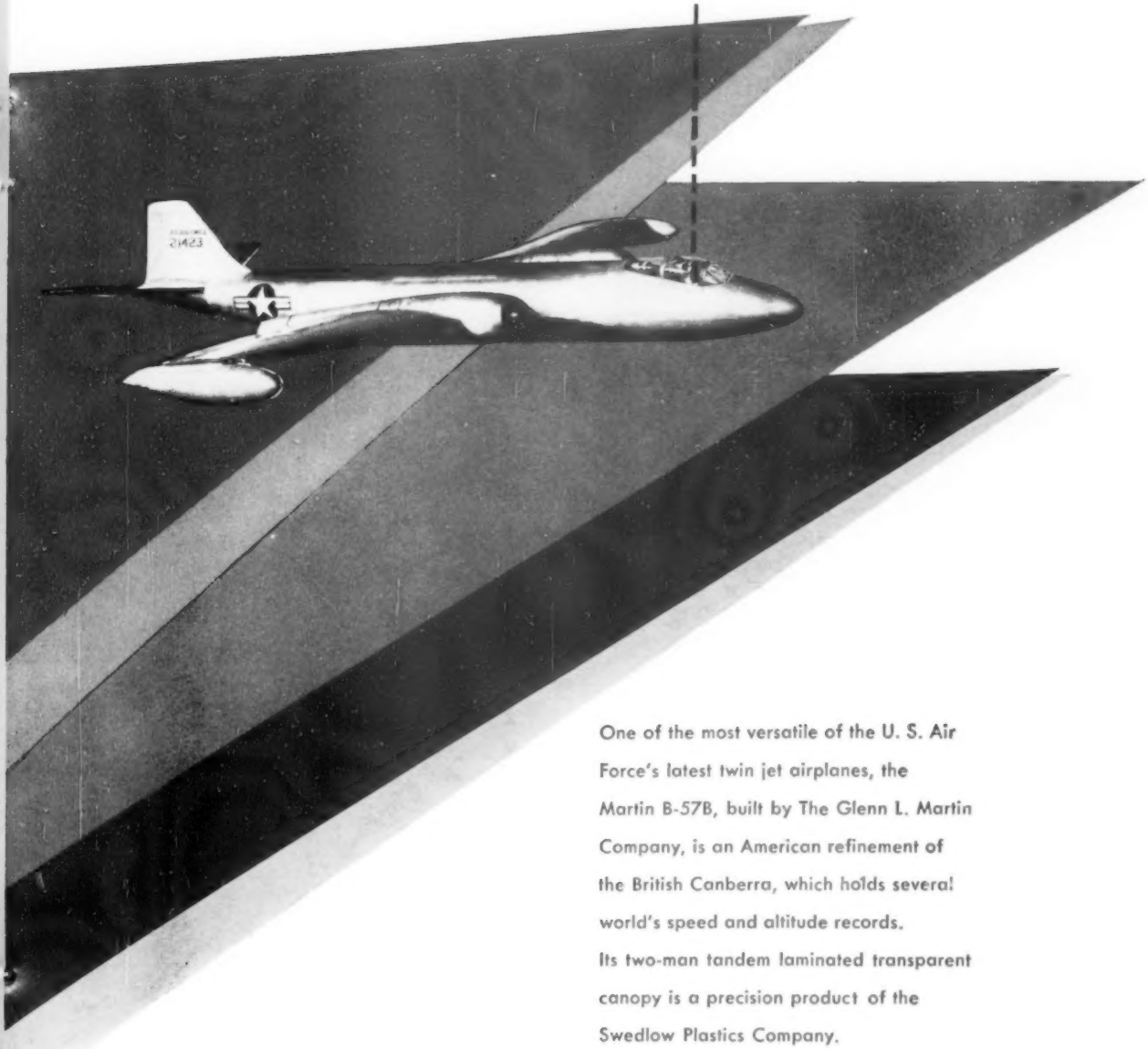

One of the most versatile of the U. S. Air Force's latest twin jet airplanes, the Martin B-57B, built by The Glenn L. Martin Company, is an American refinement of the British Canberra, which holds several world's speed and altitude records.

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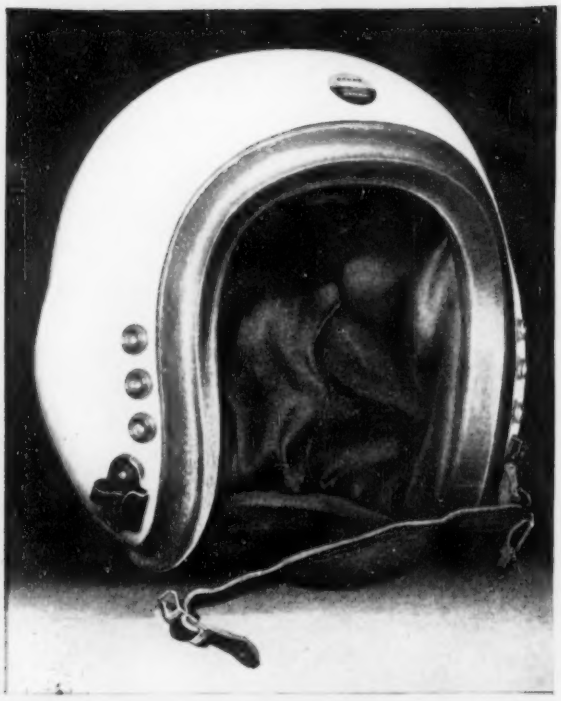

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**B-63**—Rascal—Capt. W. Jeancon, D. J. Reagan.

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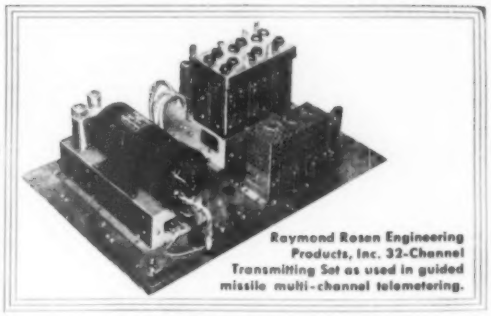

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Missile systems research and development is not confined to any one field of science or engineering. Broad interests and exceptional abilities are required by the participants. Typical areas include systems analysis, electronics, aerodynamics, thermodynamics, computers, servomechanisms, propulsion, materials research, design and fabrication.

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E. R. Quesada

E. R. Quesada
Vice President and
General Manager

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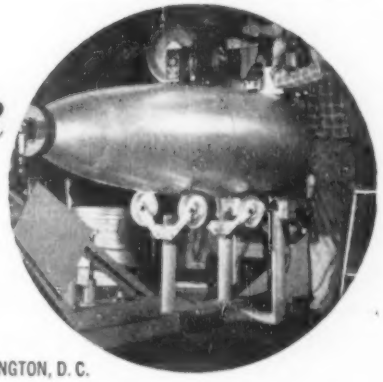

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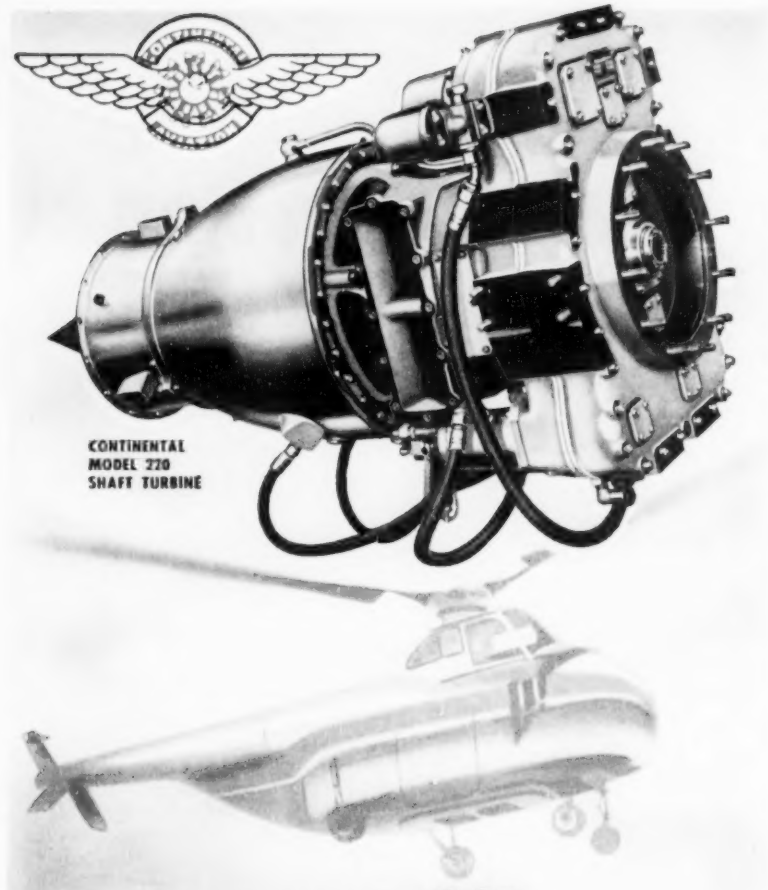


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  **Propeller Section**—Maj. W. S. McGarrah, Chief. B. Sigmon, (CO).

## Who's Responsible For What

The following listing gives the names of AMC's Air Materiel Areas and Depots and the items for which they have prime responsibility:

- **Middletown Air Materiel Area**

  Curtiss-Wright C-46 aircraft components
  Curtiss-Wright SB2C-5 aircraft components
  Convair PBY-5A aircraft components
  Kellett XH-10 aircraft components
  Piasecki H-16 aircraft components
  Piasecki H-21 aircraft components
  YH-22 aircraft components
  Piasecki H-25 aircraft components

Doman YH-31 aircraft components
L-4 aircraft components
L-16 aircraft components
L-18 aircraft components
L-20 aircraft components
L-21 aircraft components
YL-24 aircraft components
Sikorsky H-5 aircraft components
Sikorsky YH-18 aircraft components
Sikorsky H-19 aircraft components
Sikorsky XH-34 aircraft components
Lockheed P2V-5 aircraft components
Republic F-47 aircraft components
Fairchild C-82 aircraft components
Fairchild C-119 aircraft components
Chase C-123 aircraft components
Bell B-63 aircraft components
Bell H-12 aircraft components
Bell H-13 aircraft components
Wright J65 all models
Wright R 1300 all models
Wright R 1820 all models
Wright R2600 all models
Wright R3350 all models
Wright T49-W1
Packard V1650 all models
XLR-67-1/3
Wright jet engine components
Wright reciprocating engine components
Packard reciprocating engine components
Bell rocket engine components
Aircraft navigation instruments and maintenance parts
Aircraft flight instruments and maintenance parts
Aircraft engine instruments and maintenance parts
Aircraft training aids instruments standard maintenance parts
Aircraft automatic pilots and gyro controls mechanisms and maintenance parts
Miscellaneous aircraft instruments and maintenance parts
Training aids instruments and maintenance parts
Electrical meters and maintenance parts
Aircraft engine fuels and aircraft crankcase lubricating oils
Lubricants, corrosion-preventive compounds, fuels, compressed gases and cylinders
Survival equipment and parachutes
Railroad equipment and maintenance parts

**• Sacramento Air Materiel Area**

Grumman F6F aircraft components
Grumman F8F aircraft components
Lockheed RC/C-121 aircraft components
Lockheed C-130 aircraft components
Lockheed F-80 aircraft components
Lockheed F-94 aircraft components
Lockheed F-104 aircraft components
Lockheed T-33 aircraft components
North American B-64 aircraft components
North American F-51 aircraft components
North American F-82 aircraft components
North American F-86 aircraft components
North American F-100 aircraft components
North American T-6 aircraft components
North American T-28 aircraft components
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Electrical generator sets and maintenance parts
Printing, reproduction, binding auxiliary equipment

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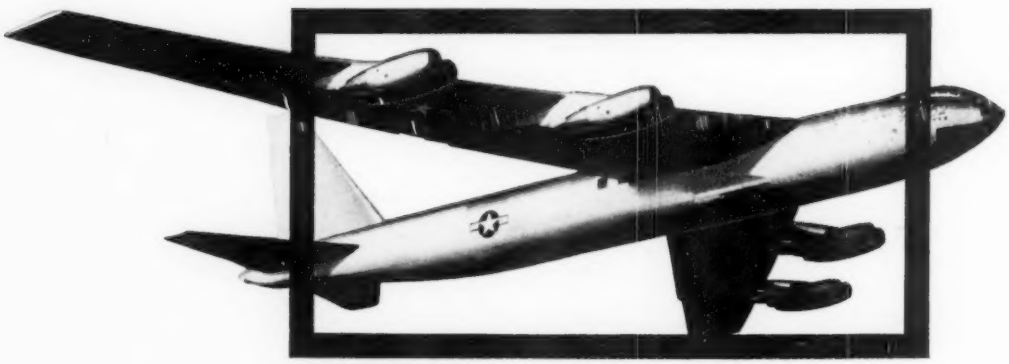
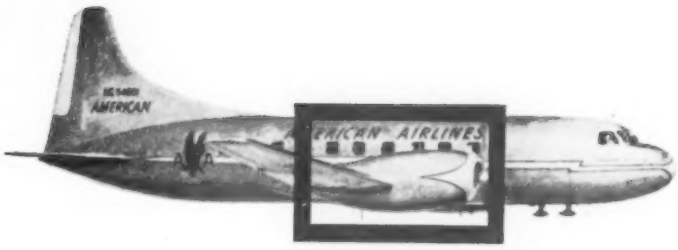


BOEING B-52




CONVAIR 340

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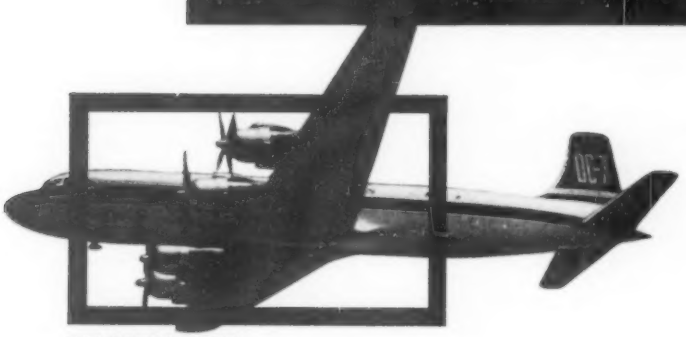

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Aircraft designers, in their constant striving to reduce weight and bulk to increase speed and payload, find Cherry Blind Rivets are more important than ever before in helping to attain these objectives.

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Gunner equipment, accessories and maintenance parts
Aircraft remotely controlled flexible gunnery fire control systems and maintenance parts
Airborne armament radar equipment and maintenance parts
Shop machinery accessories and maintenance parts
Time-keeping, navigational-computing optical instruments and related equipment and maintenance parts
Weapons emplacement equipment and maintenance parts
Catapultic devices and rocket launchers
Specially designed motor vehicles
Runway- and road-clearing and cleaning equipment
Fire trucks and fire trailers
Industrial trucks, tractors and trailers
Materials handling cranes, derricks and related self-propelled equipment
Passenger motor vehicles
Motorcycles, bicycles and scooters
Trucks and truck tractors
General-purpose trailers
Specially designed trailers
Crane shovel, basic and complete units
Crane and shovel attachments
Runway- and road-construction and repair equipment
Earth-moving and excavating equipment
Mining, rock-drilling, earth-boring, and related equipment
Tractors, track-laying
Tractors, wheeled
Truck and tractor attachments
Complete engines and maintenance parts, non-aircraft
Engine electrical systems, accessories and maintenance parts
Engine fuel system accessories and maintenance parts
Engine air and oil filters, strainers, cleaners and maintenance parts
Engine cooling and exhaust system assemblies and maintenance parts
Vehicular cab, body and frame assemblies and maintenance parts
Vehicular power transmission assemblies and maintenance parts
Vehicular brake, steering, wheel and tread assemblies and maintenance parts
Vehicular-type accessories and maintenance parts
Special-purpose vehicular fuel servicing equipment and maintenance parts
Miscellaneous special-purpose vehicular-mounted equipment and maintenance parts
Special-purpose maintenance parts for construction machinery, road-maintenance equipment and crane-mounted equipment

Airborne radar equipment and maintenance parts
Capacitors
Coils and transformers
Resistors
Switches, circuit breakers and maintenance parts
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Electrical insulators knobs and dials
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Inspection gages

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Airframe and propeller specialized tools and equipment
Armament and communications equipment specialized tools and equipment
Miscellaneous specialized tools and equipment
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Composition materials
Chemicals
Commercial hardware
Nails, keys and pins
Drive belts, drive chains and pulleys
Rivets
Cable, chain and cable fittings
Flags bunting and insignia

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Laundry and dry cleaning equipment and maintenance parts
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Subsistence

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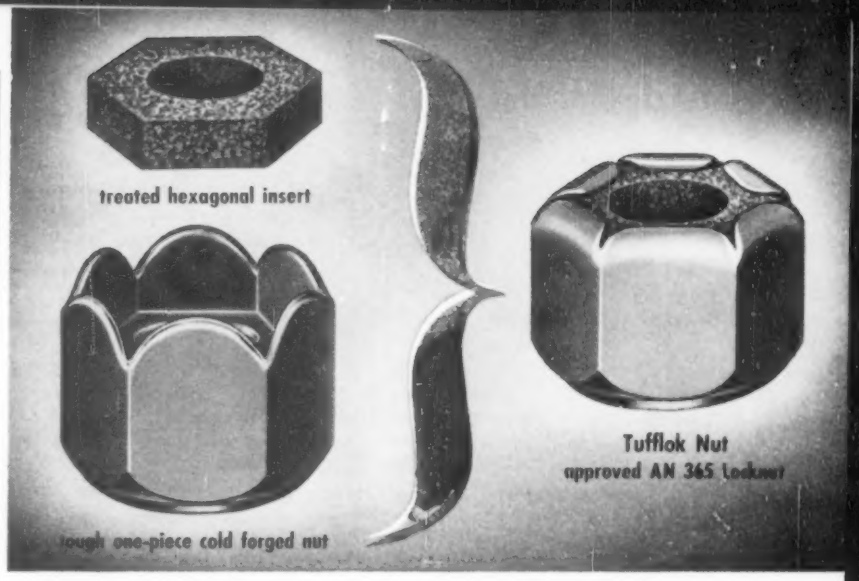
Rubber castings, tires and inner tubes
Special purpose clothing
Military uniforms, male
Personal equipage
Footwear, male
Military uniforms, female
Footwear, female
Insignia, decorations and badges
Flying field and hangar equipment
Special purpose maintenance parts for flying field and hangar equipment and materials handling equipment
Materials handling equipment
Tailored paulins and covers
Textiles, leather, fur and cordage
Notions and findings
Air Force and Dept. of Army publications
Technical orders and other technical publications
Commercial technical books, periodicals and commercial catalogue
Blank forms
Posters, charts and miscellaneous publications
Decalcomanias
Musical instruments, accessories maintenance parts and supplies
Athletic and recreation equipment and supplies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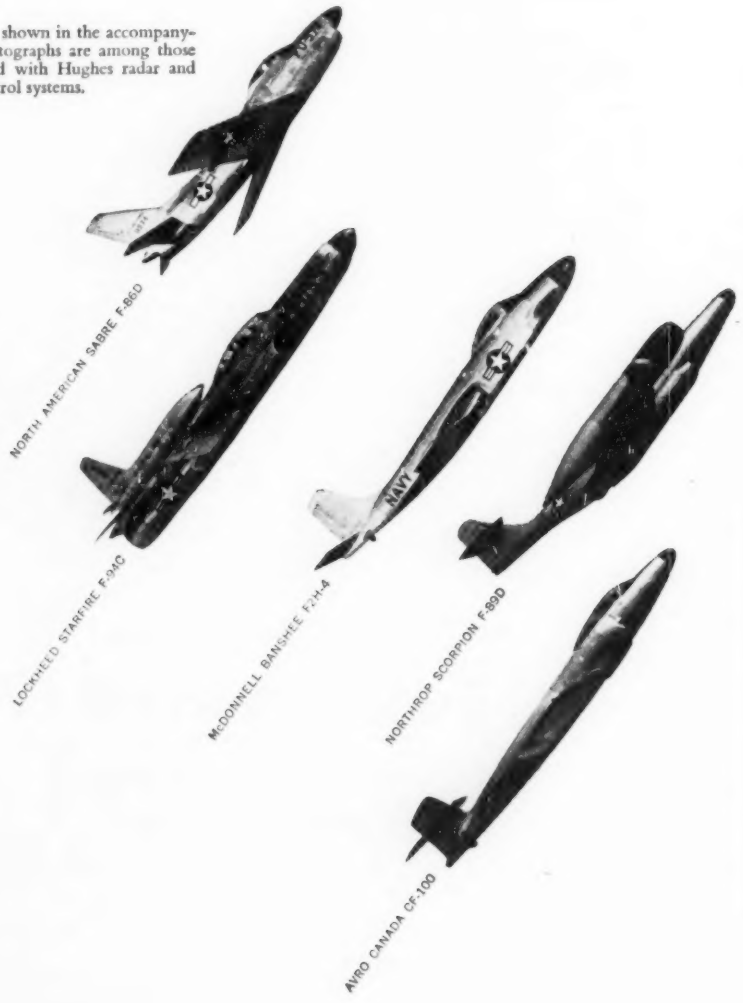
Beginning with systems engineering and analysis, the military studies are initially concerned with evaluation of the strategic and tactical needs of the services in order to establish design objectives. This is followed by the analysis of problems involving noise, smoothing and prediction, multi-loop nonlinear servos, aircraft dynamics and controls, and the properties peculiar to conversion of analog information to digital quantities. From the analytic stage evolve the requirements for systems design and circuitry, designs of computing sub-systems, microwave transmitting and receiving equipment, the presentation of information to an airplane pilot, and advanced testing needed to optimize over-all system performance.

Aircraft shown in the accompanying photographs are among those equipped with Hughes radar and fire control systems.

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***CIRCUIT ENGINEERS***

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Ground radio communication equipment and maintenance parts
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Heating, ventilating, plumbing, steamfitting equipment accessories and maintenance parts
Furniture and fixtures
Furnishings
Packaging material
Agricultural equipment implements and maintenance parts

**• San Bernardino Air Materiel Area**

Douglas B-26 aircraft components
Douglas RB-66 aircraft components
Douglas C-47 aircraft components
Douglas C-54 aircraft components
Douglas C-74 aircraft components
Douglas C-117 aircraft components
Douglas C-118 aircraft components
Douglas C-124 aircraft components
Douglas C-132 aircraft components
Douglas C-133 aircraft components
Hughes H-23 aircraft components
H-23 aircraft components
XH-26 aircraft components
XH-28 aircraft components
YH-30 aircraft components
H-32 aircraft components
L-17 aircraft components
Hughes XGAR-1 aircraft components
North American B-25 aircraft components
North American B-45 aircraft components

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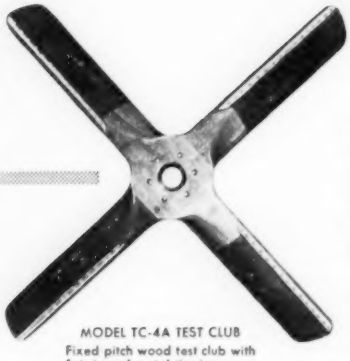

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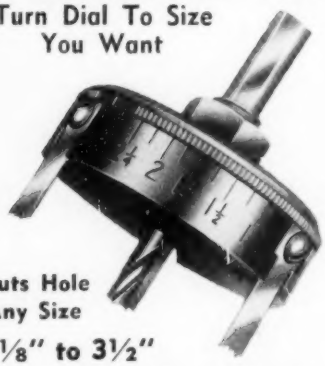

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O405-9

O425-1/9

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R755-A2/11

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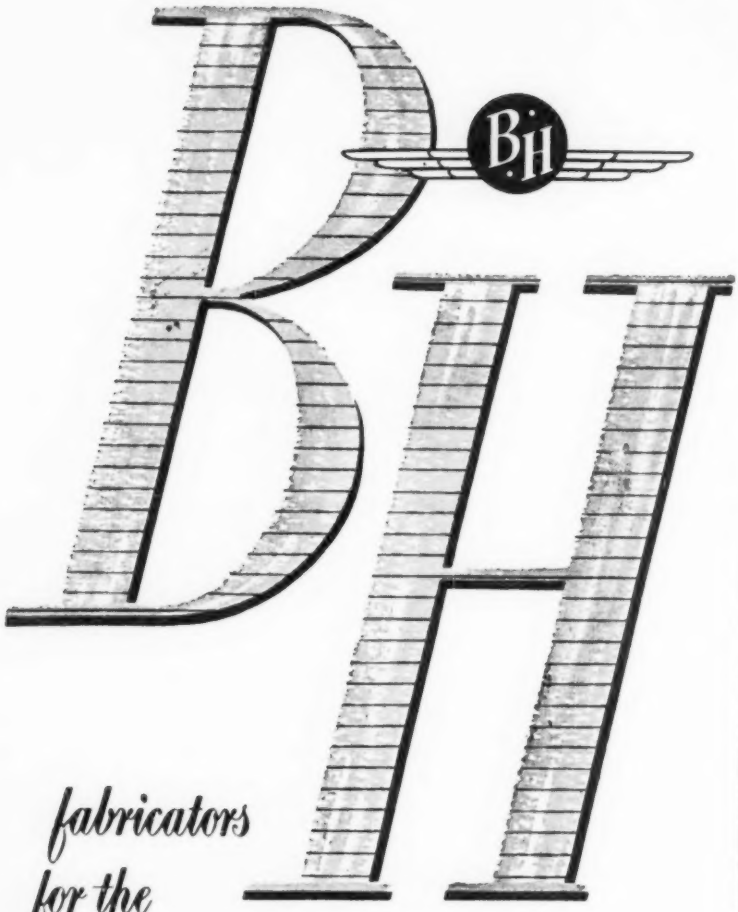


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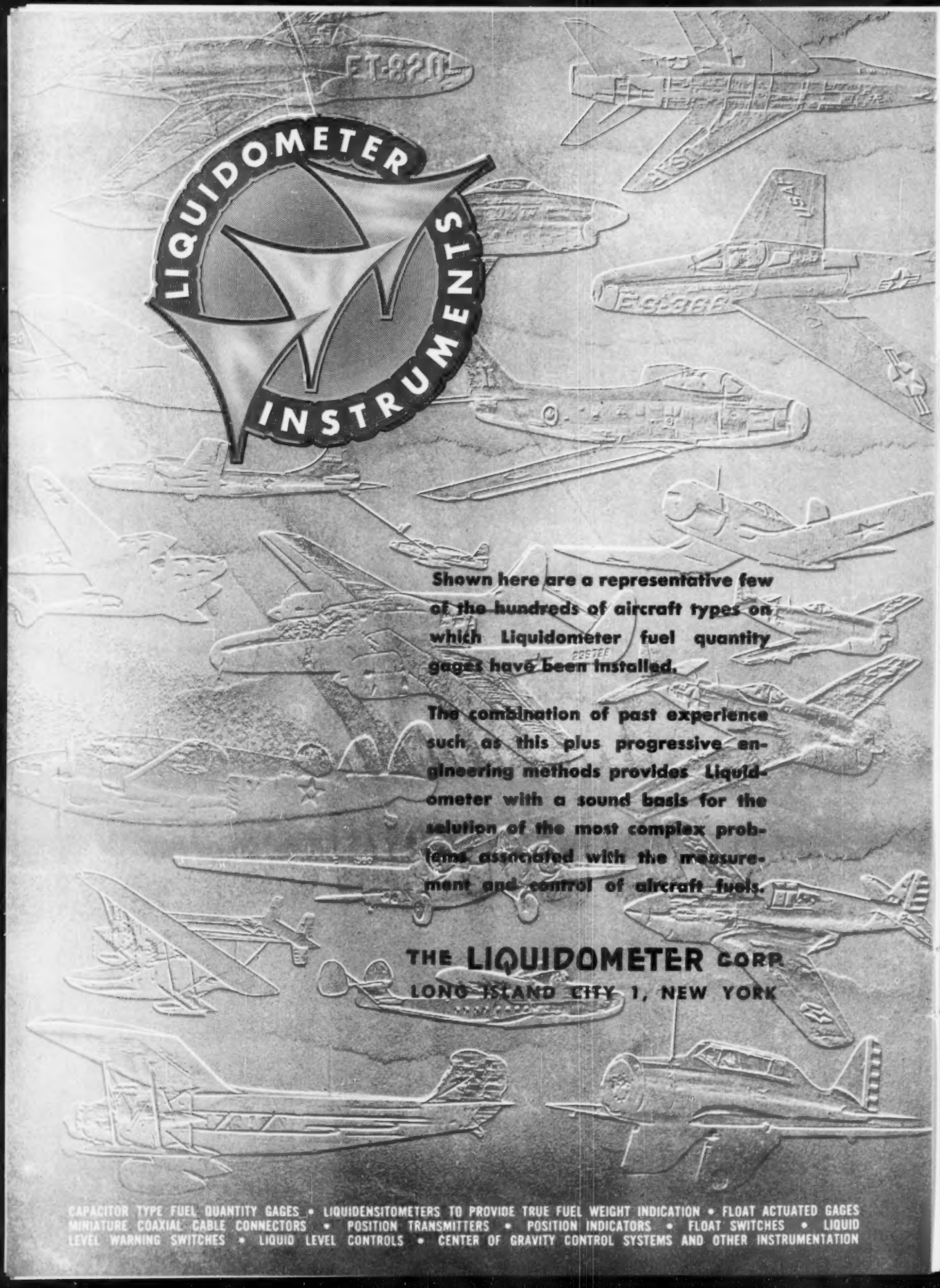


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## Air Force Pushes Catalog Program

AMC has established ground rules for converting Air Force supply cataloging, supply data records, and bookkeeping systems to the Federal Cataloging Program.

These rules have been distributed within the Air Force in a 20-page Master Plan which sets forth how the Air Force, during the next several years, will accomplish the conversion with minimum disruption to supply operations.

Through the Master Plan procedures for conversion, Air Force is striving to obtain the fullest possible advantages from the Federal Catalog Program. This program was established under the Defense Cataloging and Standardization Act (Public Law 436), passed by Congress in July 1952. It is a single and uniform catalog program for the Armed Forces, and sets up a common supply language for all items of supply in the military logistical system.

The Federal catalog data eventually will list every item repeatedly purchased, stored, and issued by the Army, Navy, and Air Force.

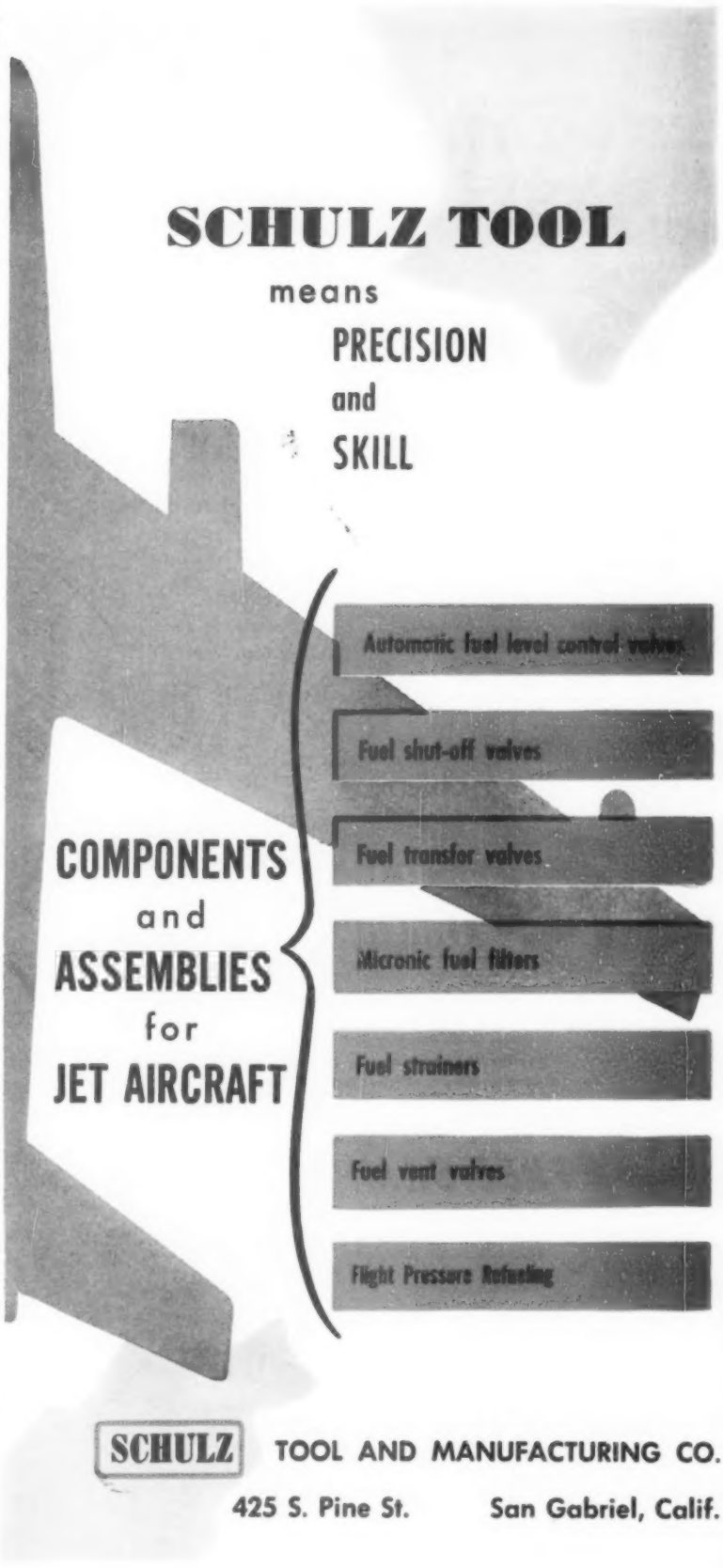
► **One Number**—Under the new single catalog program, the Army, Navy, and Air Force will use one stock number and description to identify each identical supply item used by any or all of the three services. Such use is designed to aid in the interchange of item data, promote greater interchangeability of supply items between the Armed Services, prevent the accumulation of excess property, simplify procurement and to secure other logistical benefits, improvements, and savings.

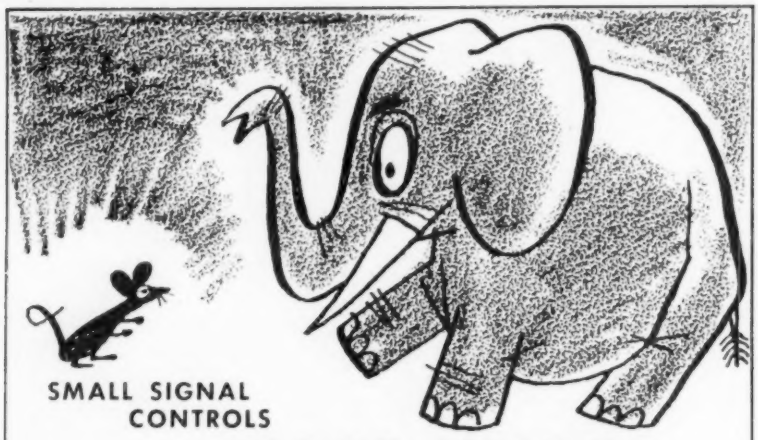
The job of supplying the items also will be greatly simplified for industry, by a reduction in the present variety of numbering systems manufacturers are obliged to follow when supplying identical items to the military.

► **First Step**—Announcing the Master Plan in a detailed report on the Air Force's progress thus far in the Federal Cataloging Program, Gen. Rawlings, AMC Commander, emphasizes that today's progress is merely the beginning. He points out that the conversion of the Air Force supply cataloging and records is only part of the broad program. Actually, the full Federal Program will not become effective in the Air Force until additional logistics, cataloging, and standardization projects are completed.

The most important such projects now being worked out are the formulation of:

• **Detailed plans and procedures** for full utilization of Federal catalog data to best advantage within the multiple func-

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tions of the Air Force's materiel management structure. Included among these are such typical functions as budgeting and funding, requirements computation, procurement and production, maintenance, quality control, storage and distribution, handling and packaging, accounting, and disposal. These plans are being progressively formulated under a master Federal schedule. This schedule is organized according to some Federal supply classes of property. However, some of the plans already have been put into effect.

• **Arrangements with the Air Force,** Army, and Navy for a coordinated schedule of "effective" conversion dates for specific categories of materiel. Coordinated arrangements for some of these categories also have been completed.

• **Plans for specific methods** to improve the efficiency and reduce operating costs of the Air Force logistics system, through simplification and standardization of supply items.

Gen. Rawlings says Air Force is entirely in accord with the broad objectives and principles established by the Defense Cataloging and Standardization Act.

"The concept of a single supply language, a single supply classification, stock numbering, and supply catalog system as a tool and service for a single supply system is the basis of the Air Force's logistical operations. The logistical 'facts of life' extending over the past 36 years of the Air Force's materiel management have convinced us of the concept's soundness," he says.

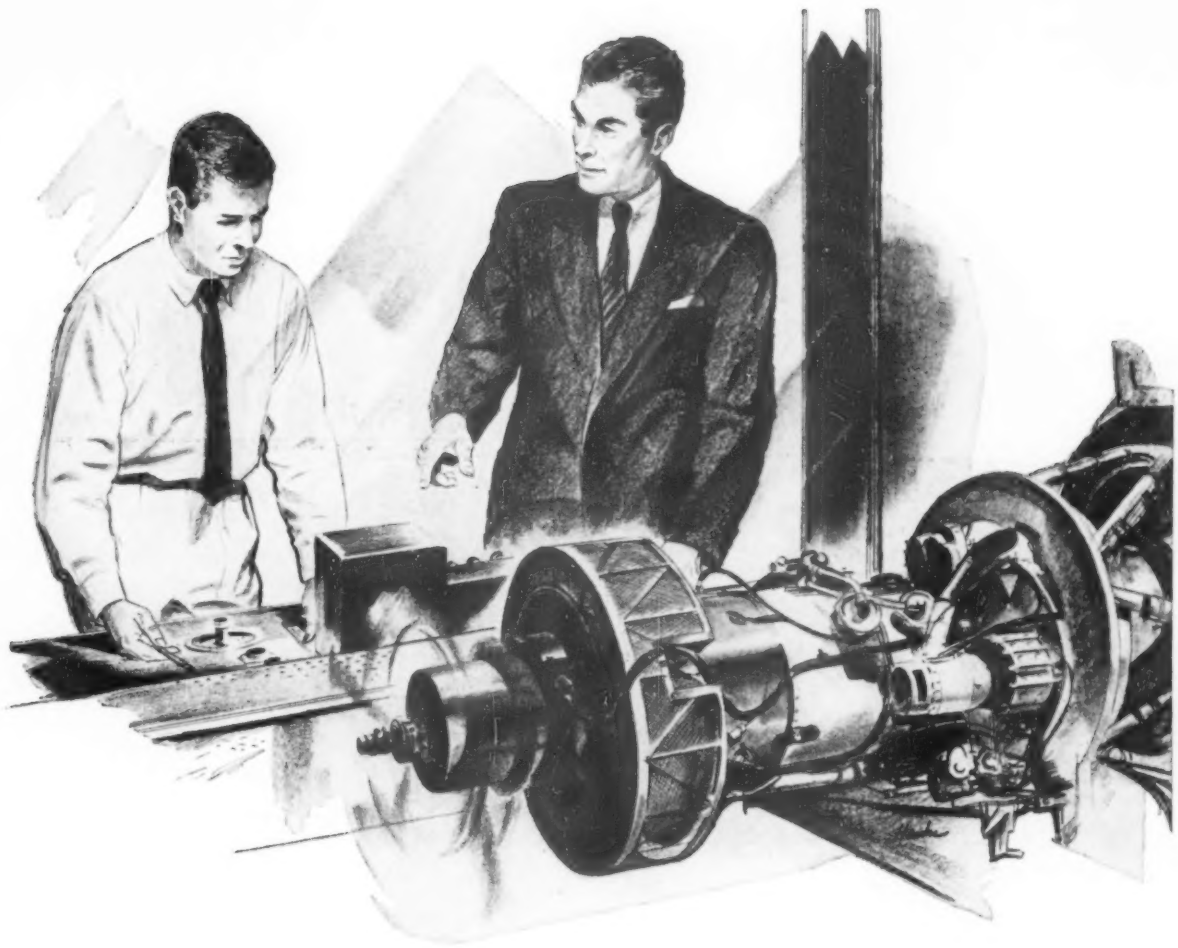
"The Federal program of cataloging therefore imposes no abrupt change in our general concepts and approach in supply cataloging and materiel management," he points out.

"In fact," the general continues, "the Air Force is using Federal item identification data in all applications that are possible prior to actual conversion. These actions are aimed toward minimizing as much as possible the disrupting effects that inevitably accompany any conversion of records, and the remarking of item locations, tags, and item labels."

▶ **Changeover**—Specifically, the Master Plan provides Air Force installations with the policy, objectives, and guides for changeover from the use of existing catalog numbers and item description data to the use of the new Federal catalog data.

Under these ground rules, AMC already is making substantial progress in using the available data produced through the Federal Cataloging Program.

For example, new items entering the Air Force supply system and items already in the system have been, or are



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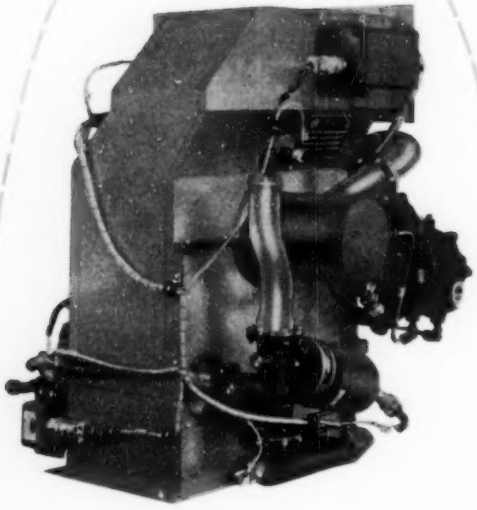

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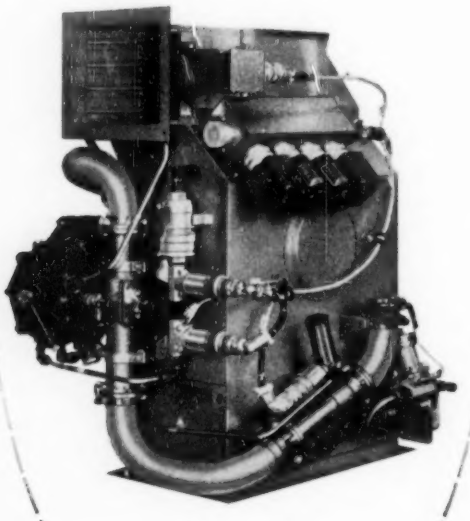

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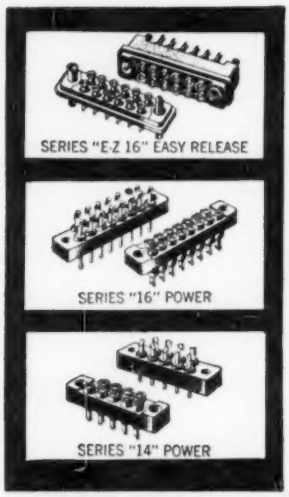


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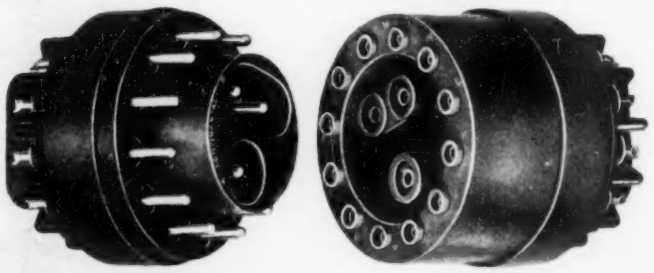

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being described and numbered in accordance with the Federal cataloging rules, principles, and schedules. Approved Federal items names are now used in titling new or revised Air Force drawings, specifications, and similar documents. Federal identification numbers are being recorded in the catalog indexes as rapidly as they become available, upon assignment by the Department of Defense.

AMC also is assembling cataloging data for use in projects of standardization of supply items, and in determining and registering information on item interchangeability and item substitutes.

This information will be made progressively available in the Air Force Supply Catalogs and Stock List Publications. In effect, the data thus established in the Air Force and Federal Cataloging Program operations provide a springboard from which to reach the objectives of standardization under the Defense Cataloging and Standardization Act.

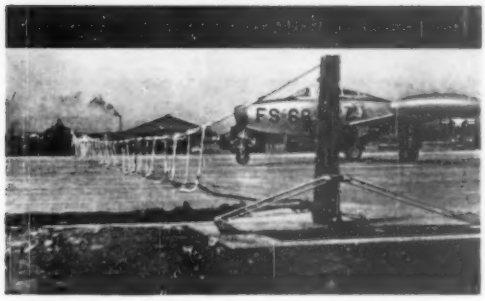
► **Property Classes**—Under the Master Plan, approximately 27 Air Force property classes will first be converted from the present identification and classification system to three of the 74 Federal Supply Classification Groups—including clothing, fuels and lubricants, and medical items on June 30, 1954. Included among these three FSC Groups are about 30 Federal Supply Classifications.

In carrying out these objectives, AMC first will align Air Force Depot responsibilities for materiel management by the Federal Supply Classification structure.

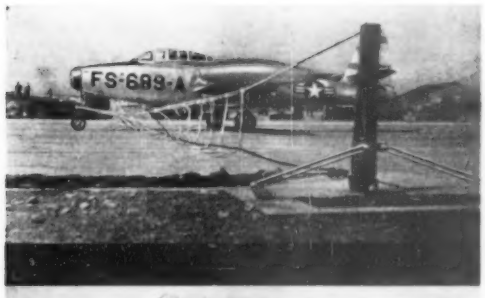
For example, Headquarters AMC already has assigned to the Wilkins Air Force Depot at Shelby, Ohio, the responsibility for Federal Supply Group 84, "Clothing and Individual Equipment." Therefore, after June 30, all operational control for commodity management of clothing items will be centered at Wilkins, including the clothing stock fund, procurement, requirements computation, distribution, item identification, and related functions. The supply responsibility for some items may change as conversion advances.

Upon the effective conversion data for FSC 84, the change of records to use the Federal stock numbers and descriptions will be effected not only at Wilkins AFD, but also at all other Air Force worldwide activities where supply records are maintained on clothing.

No definite date has yet been established for converting the remainder of Air Force supply classes of property to the Federal Cataloging system of supply classifications and catalog data, but the task will be accomplished in accordance with a master "conversion" schedule handed down by the Department of Defense. A coordinated Air Force, Army, and Navy proposed con-



# HOW MANY DOLLARS WORTH OF LIVES CAN WE SAVE?



*These sequence photographs show an F-84 jet fighter, simulating a brake-less landing at approximately 120 m.p.h. Top: plane approaches Runway Over-run Barrier consisting of nylon webbing and steel cable, affixed to twenty tons of steel chain, and attached to steel stanchions. Next: webbing is engaged, raising cable to landing gear height. Third photo: Landing struts pull cable taut, breaking it away from stanchions. Bottom: chain is pulling plane (out of photo) to smooth 200-foot stop.*

It's impossible to figure lives in dollars and cents. That's why Acme Aluminum Alloys, Inc., considers its contract to construct Runway Over-run Barriers currently scheduled for continental United States Air Force installations as one of the most valuable it's ever received.

No question, the "barrier" is a life-saver. Since Captain John E. Snow and his group of technicians completed their first successful installation, barriers on Far Eastern Air Force bases have saved at least forty planes and their pilots . . . and more than ten million dollars worth of aircraft.

Acme Aluminum Alloys, in its own dependable way, is rushing the currently-scheduled barriers to completion. Numerous unsung Air Force personnel are helping to meet an early deadline. Soon, more bases will be equipped, saving aircraft worth millions of dollars and more important, saving lives upon which no value can be placed.

Acme

**ALUMINUM ALLOYS, INC.**

233 North Findlay Street, Dayton, Ohio

Business and government executives know that it pays to ask for an Acme bid when letting contracts for design and engineering work, tooling, special machinery, process engineering, precision aluminum castings, finished machining, or fabrication of complete assemblies from pre-established or Acme-developed blueprints and specifications.

As in the case of the barrier, Acme may be able to provide life-saving quality at lower finished cost.

*beyond the sonic wall*

# precision *spells* performance!

SPECO

● New heights of performance demanded by supersonic flight, also demand new standards of precision . precision assured by the know-how and production facilities with which we have served the aviation industry in development work for many years

We manufacture precision gear assemblies for accessory drive units, actuators, transmissions, computers and controls. And we also produce complete components such as bomb hoists, gun turrets, radar tracking and scanning assemblies, hydraulic actuators.

Make **your** development and production problems **our** problems We're qualified by long and proven performance to solve them . large or small.
A letter or telephone call will put us at your service.

**THE STEEL PRODUCTS ENGINEERING CO.**

**ENGINEERS AND MANUFACTURERS • SPRINGFIELD, OHIO**

version schedule will be submitted to the Congress in April by the Department of Defense. Conversion to specific Federal supply classes will be accomplished simultaneously at approximately 300 Air Force installations throughout the world. Conversion of all items will be spread gradually over the next four to six years.

▶ **Big Job**—The magnitude of the change-over can be measured by the fact that the average Air Force base is estimated to carry about 40,000 different supply items. With approximately 300 installations in the world, this means that about 12 million items records must be changed during the next several years.

All documents carrying a stock number and description must be converted to the Federal numbers and description data. This applies to bin cards, locator files, contracts, stock records, regulations, equipment tables, authorization lists, and all similar documents.

Approximately 500 Federal Supply Classifications and sub-classifications will exist when conversion is completed. The present Air Force classifications will be discontinued. There are approxibe converted into about 80 per cent of mately 290 Air Force classes, which will the Federal Supply classes.

AMC now is conducting a command-wide educational program to indoctrinate logistical personnel in the effect and impact of changes involved in the transition to the Federal Cataloging Program. An orientation program is being provided for the benefit of staff officers of all Air Force commands. Training is being extended to Supply technicians and employes at the operating levels.

The educational program is being conducted through several different methods. The Air University at Maxwell Air Force Base, Alabama, is including cataloging courses in its curriculum. AMC is holding cataloging forums and seminars, and distributing information through such media as information letters and training guides.

The number of employes assigned to cataloging functions at Headquarters AMC and identification activities at AMA's and Air Force Depots has been augmented. A commercial contractor has been employed to help prepare Federal item descriptions at the AMC Cataloging Division.

## AF Tightens Control On High-Cost Items

AMC is monitoring a far-reaching accounting system, designed to tighten control over the procurement of high-cost aircraft supplies and equipment.

Under the system, approximately

New
Douglas A4D
Skyhawk uses...
NAVY
WESCO
SOLENOIDS
for accurate, reliable
actuating force!
Like Douglas Aircraft, you, too, can find the right WesCo DC solenoid for your application. Simply send your specifications to our design engineers.
The WesCo trademark appears on solenoids throughout the world—in aircraft like the revolutionary new Douglas A 4 D Skyhawk, America's smallest and lightest combat plane, in instruments and a wide variety of electrical and electronic applications.
If you have not yet written for your copy of the new WesCo DC solenoid catalog, do so today, on your letterhead. The catalog is extremely helpful to you, containing 50 pages of engineering drawings and design information, temperature and work curves, and other features to help you select the right solenoid for your needs. Since quantities on the initial printing are limited, be sure to write today.
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Now—continuous direct information about wing lift at a glance! The revolutionary Safe Flight Speed Control System eliminates last minute calculations of gross weight, acceleration, configuration, turbulence, etc. . . . automatically displays the best lift coefficient at critical take-off and approach speeds. Fewer high-speed landings with excessive wear on brakes and tires. No excessive reverse pitching and overshoots!

Constant checking of the airspeed indicator is unnecessary: when the pointer of the Speed Control Indicator is on the triangle, speed and attitude are correct . . . initial climb is best under existing power and weight conditions. The Speed Control System's instantaneous non-lagging operation is particularly important in the event of engine failure in multi-engine aircraft after take-off.

Speed Control System components, including the Safe Flight Lift Transducer and Lift Computer—are rugged in design, unusually free of maintenance. Wing transducer coils are completely sealed. Flag alarm provides fail-safe indication.
Speed Control System meets all pertinent Air Force, Navy and Civilian specifications.

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*"Pioneers in Lift Instrumentation"*

*WHITE PLAINS, NEW YORK*

727,000 cataloged items in the Air Force inventory are segregated into three different categories:

- **17,000 items,** which have a unit cost of $500 or more. They represent only 2% of the number of cataloged items, but 42% of the total monetary value.
- **160,000 items,** which have a unit cost of $10 to $500. They represent 23% of the number of cataloged items, and 40% of the total monetary value.
- **550,000 items,** which have a unit cost of less than $10. They represent 75% of the total number of cataloged items, but only 18% of the total monetary value.

This program categorizes Air Force supplies and equipment so that refined controls and accurate statistics are maintained on these items which account for the bulk of dollars in the inventory. Inventory and reporting procedures governing low-cost items are relaxed.

The plan rectifies the deficiencies of the previous system, under which the 10-cent and the $50,000 items received identical attention from an accounting and reporting standpoint.

AMC points out that the impact of the cost category system, which is regarded as one of the most far-reaching management improvement projects ever undertaken by the Air Force, cannot be measured merely in terms of dollars and cents.

However, AMC emphasizes that tight accounting controls over high-cost items insures procurement of such items on a more selective basis. Relaxed control of low-cost items greatly reduces the amount of paperwork. Air Force bases realize the greater portion of savings derived from the relaxation of controls on low-cost items, while the depots realize considerable savings through the placing of inventory reports on an annual basis. Inventory reporting previously was on a quarterly basis.

AMC says it had been working for a decade on a plan to categorize inventories into groups commensurate with their value. But, it added that the practical aspects of the problem did not lend themselves to simple solutions, because of the vast inventory of supplies and complex logistics operations.

Practically every private management consultant and government management group who ever studied AMC's supply system offered helpful suggestions with regard to the basic philosophy of the needed accounting system. But steadily increasing Air Force austerity and the rapid increase in inventories magnified the need for managing the supply system with greatest efficiency.

Accordingly, an AMC management project—known as the Inventory Categorization Program because it spotlighted high- and low-cost items—was established.


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Rocket engines
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Major bomber components

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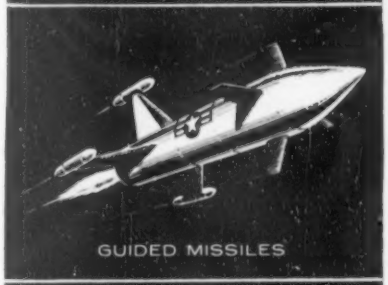
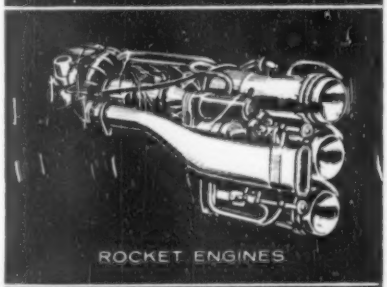
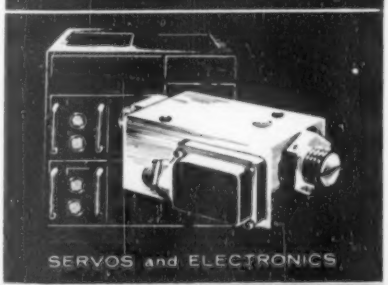
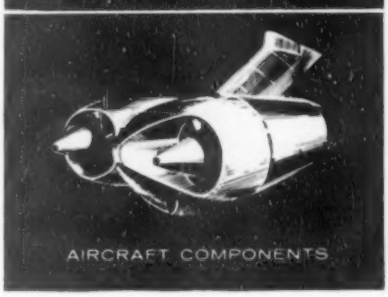


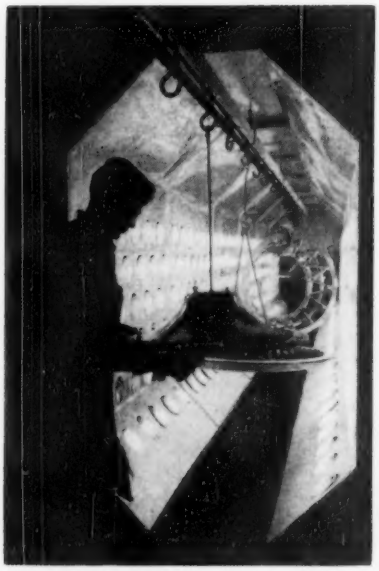



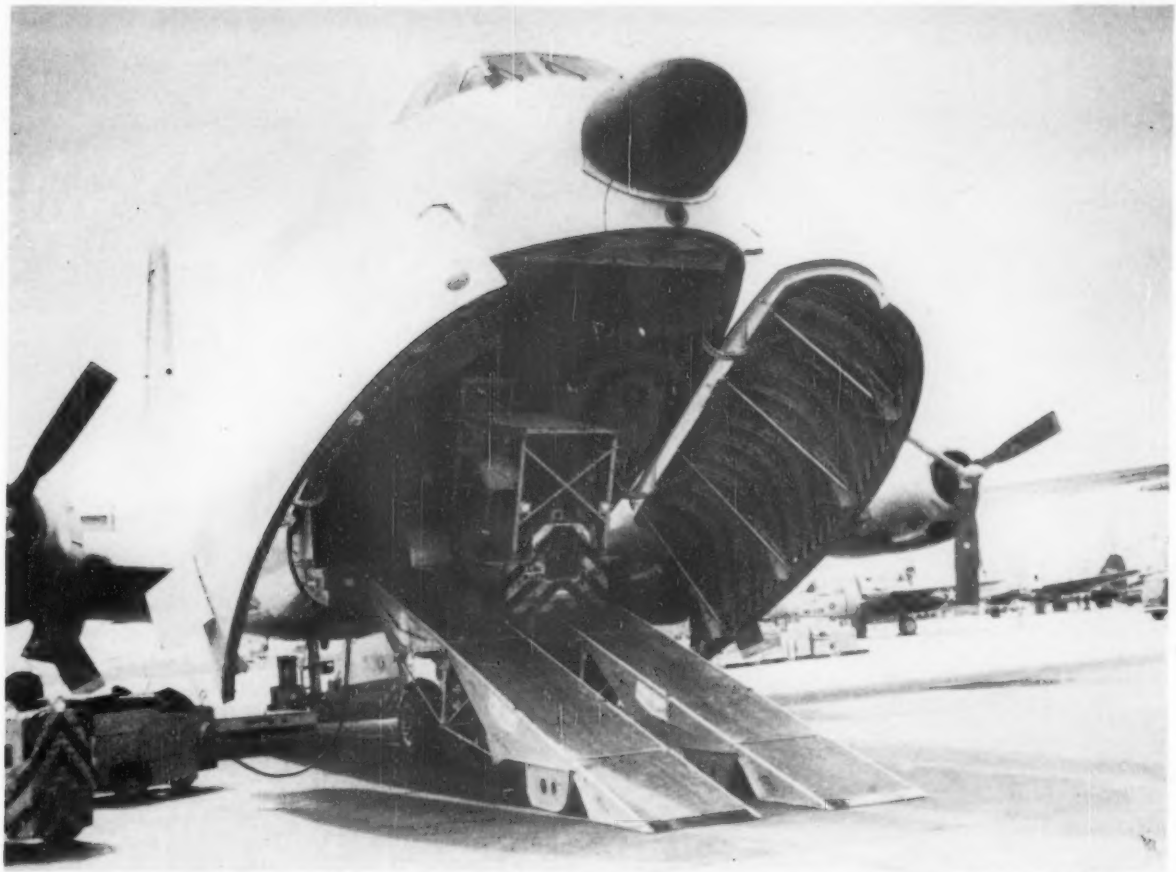
**McCLELLAN AFB** packs pre-loaded cargo bins awaiting airlift to Pacific and the Far East by Convair XC-99 giant transport.

# Air Materiel Command at Work

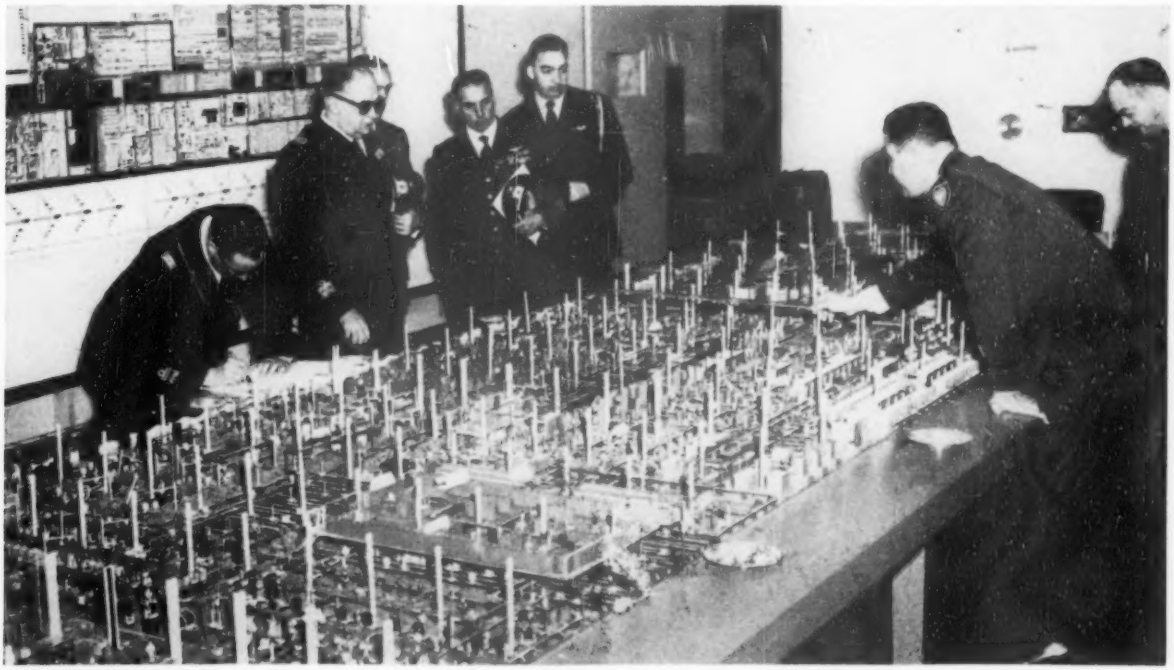
**MIDDLETOWN AMA** runs damaged clothing and other personal equipment through repair line that makes it usable.



**JET ENGINE PARTS** get infra-red drying treatment for enameled parts at Olmsted.

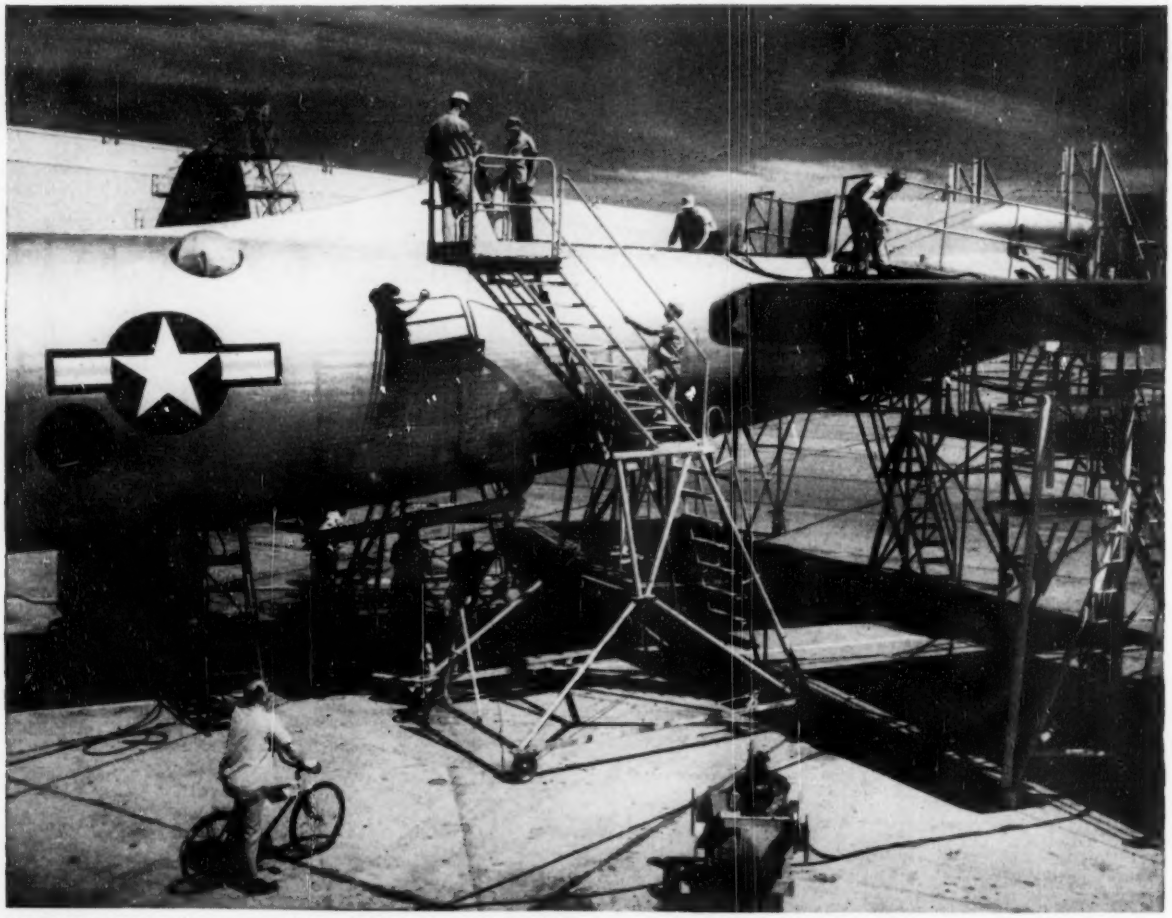


**INTEGRAL CARGO HANDLING** equipment of Douglas C-124 transport speeds movement of supplies through AMC aerial pipeline.

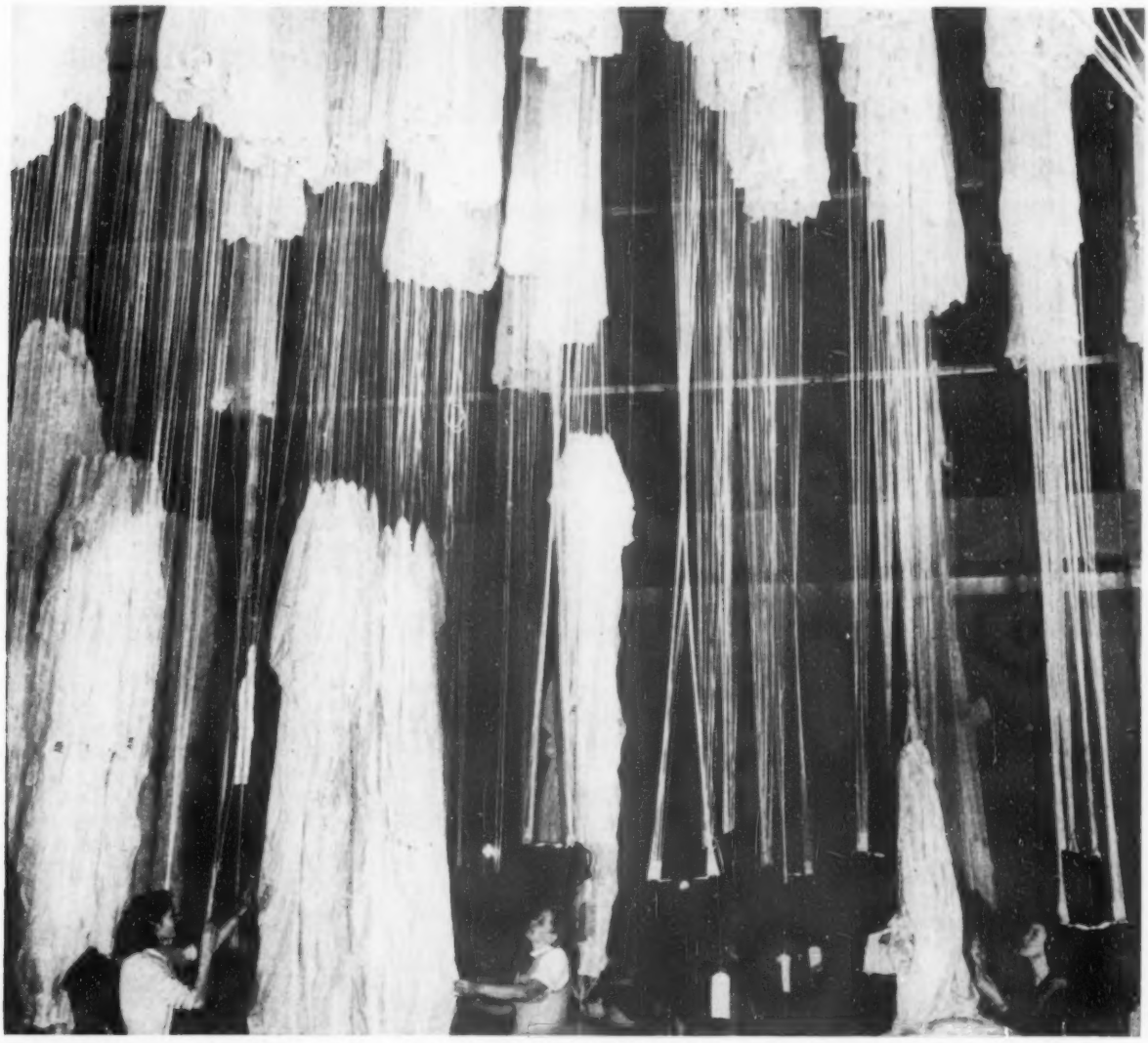


**LOGISTICS OFFICERS** from NATO air forces are trained in AMC methods of handling maintenance and overhaul of U. S. equipment.

**AUCTIONEER** knocks down $37,000 worth of surplus property in cash sale at McClellan AFB. AMC handles USAF surplus disposal.

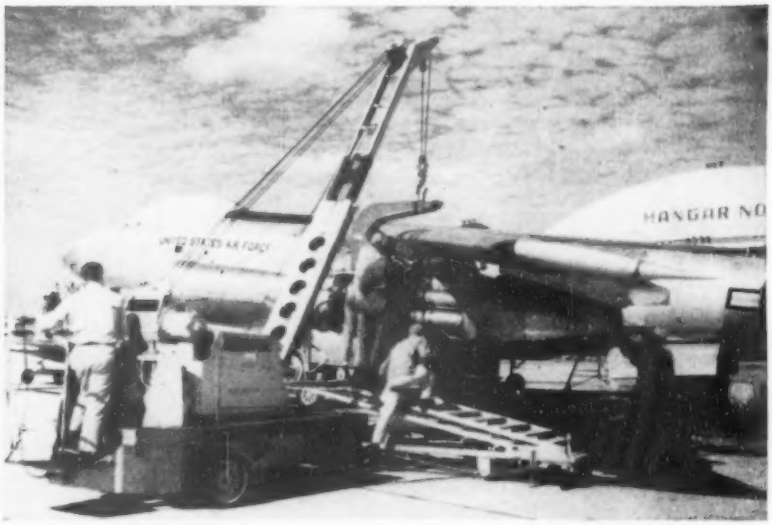


**VERTICAL FIN** has been removed from B-36 as part of SAM-SAC program to modernize and recondition long-range bomber fleet.

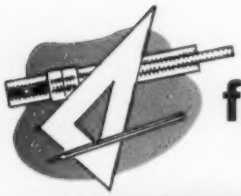


**PARACHUTES** ranging from those used by pilots to giant 100-ft. size used for cargo drops are repaired at McClellan AFB.

**JEEP OVERHAUL** at Olmsted AFB.




**GENERAL ELECTRIC** J47 is removed from B-47 for overhaul at Tinker AFB.



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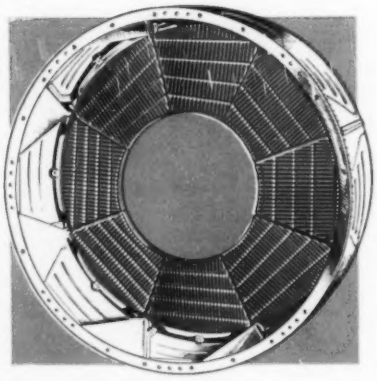

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## New Ground Rules To Speed Disposal

USAF, in a drive to clear out "deadwood" from its supply system, has established a three-point program designed to speed up the isolation and sale of large quantities of surplus property.

The program, sponsored by Air Materiel Command, provides:

• **New disposal ground rules** which greatly expand the number of items which can be cleared out of Air Force inventory. They replace "Project Spring Clean," which has been the backbone of the Air Force's disposal program during the past two years.

• **New merchandising methods** to broaden the market and speed sales of surplus property, and increase the dollar return per unit sold.

• **New disposal task groups** at Air Force Depots to expedite the disposal program.

The new disposal criteria establish life expectancy for additional aircraft models not included in Project Spring Clean.

Gen. Rawlings, AMC Commander, points out that during the past two years Air Force has been taking aggressive action under Project Spring Clean to dispose of stock no longer needed. However, Project Spring Clean did not go far enough, and it is expected that the new criteria will produce a substantial increase in the amount of property that will be available for disposal.

In a letter to all Air Force Depots outlining the new disposal policies, Gen. Rawlings has requested that special effort be made to compute the quantities of property to be sold, and that it be moved rapidly out of the Air Force supply system.

Sale of the property will aid in providing critically needed warehouse space for new-production items.

▶ **Big Screening Job**—Disposal of excess property is a multiple-screening process which exhausts every possibility for other use of the material before it is eventually disposed of as surplus. The property is first made available as excess to other government agencies for possible use in its original capacity. If no other agency can use the property, it is disposed of, under specified conditions, as surplus.

New merchandising practices will be introduced in the selling of this property through government surplus sales. This is designed to simplify sales techniques, speed up the turnover of surplus property, increase the dollar return per unit, and reduce the work load in the distributions to bidders and preparation of contracts. Such sales also are expected to make it possible for small

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A supersonic jet fighter on a bombing or rocket-strafing mission needs something special in the way of a camera for recording impact and destruction by its weapons. Such a camera is the Maurer P-2 illustrated.

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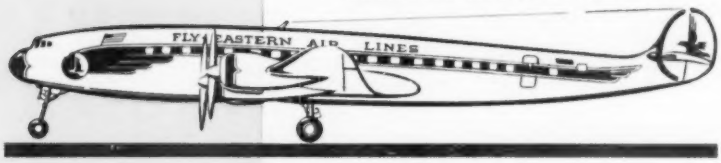
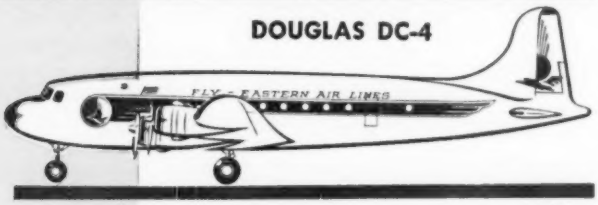



CONSTELLATION 749A

DOUGLAS DC-4

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Eastern Air Lines (in common with most of the world's airlines) derives multiple advantages from the use of Vickers Hydraulics. First, it has the best aircraft hydraulic equipment available. Second, it obtains the many benefits of standardization. Third, it has the undivided responsibility of a single source.

Vickers Hydraulic Equipment has proved by hundreds of thousands of hours in the air its claims of longer life, greater dependability, better performance and lower maintenance.

The interchangeability resulting from standardization means a smaller and more flexible inventory of spare parts. It minimizes the number of test and inspection fixtures. It makes for quicker and easier training of maintenance personnel through the need for familiarization with fewer products.

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consumers to participate.

One of the innovations is designed to make it more easy for individual consumers to purchase surplus property which has a high public sales appeal. Included among such items are clothing, hardware, electrical supplies, and furniture. Common items will be sold in small lots of one, two, six, 10, 15, etc., units.

Improvised counters will be used at the government surplus sales to display the items, for the convenience of individual consumers. Showcards on each lot of merchandise will indicate the government purchase price, and a description of the item.

► **Aid to Small Buyers**—A period of time will be alloted for inspection of merchandise immediately preceding the opening day of bids. Bids will be limited to the opening day to induce bidders to be present on the day of the sale. Some sales will be conducted on Saturdays to encourage maximum attendance of small buyers and permit immediate award of bids and removal of property sold.

Each government surplus sale will be advertised widely in newspapers, magazines, and radiocasts, so that the public will be fully informed of the dates and places of the sales.

A disposal task group already has been established at Headquarters, AMC to expedite the disposal program. Such groups are now being established at each Air Force Depot to insure additional drive to the disposal program. Included among the objectives of these groups is the development of a merchandizing program which will provide maximum return on items offered for sale, based on sound business management practices.

AMC re-emphasizes that the easiest way for a prospective buyer to find out about government surplus sales is to visit or write his nearest Air Force Base. He will be given a form to complete, showing the prospective buyer's address, what he wishes to buy, and where he wishes to buy it. No matter which Air Force Base the buyer contacts, his name will be entered on the bidders' list in the area he specifies.

## New Plan Set Up For Surplus Disposal

The first meeting of the Defense-General Services Administration Industry Advisory Committee on Disposal of Surplus Property has resulted in industry endorsement of a proposed marketing plan for disposing of surplus property.

Headquarters, AMC, announces that the plan is expected to be placed in effect soon throughout the Air Force.

The committee was organized to

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assist the Department of Defense and the General Services Administration in seeking solutions to the more difficult aspects of the disposal problem.

The approved merchandising plan applies to all preparations for sale and sales of surplus personal property in the Department of Defense, including contractor inventory and foreign excess. New features of the plan include:

• **Provision for withholding** of surplus property from the commercial market where the sale of such property will adversely affect the commercial market until after the appropriate industry divisions of the U. S. Department of Commerce have made technical recommendations on the situation to the Assistant Secretary of Defense (Supply and Logistics) who will make the final determinations.

• **Reporting in advance** of all surplus sales of usable property within U. S. having acquisition cost of $250,000.

• **Establishing a uniform deposit** of 20% of bid price, when a deposit is required.

• **Setting up a procedure** whereby buyers who cannot personally attend an auction can bid on certain items or lots by sealed bids.

## AMC Teams Guard Quality Control

Air Material Command has instituted a modernized and highly effective quality control system that has resulted in Air Force equipment being of higher quality than in former years.

The importance with which this aspect of AMC's activities was regarded was indicated two years ago when a new staff office—Quality Control—was formed from a merger of the separate Quality Control functions in the Directorates of Procurement and Production, Maintenance Engineering and Supply and Services.

▶ **Contractor's Responsibility**—Today, it is the responsibility of the contractor to maintain control of quality at or above minimum Air Force standards. An Air Force Quality Control representative surveys the contractor's inspection system and verifies the inspections to insure that quality does not drop below Air Force requirements.

The Quality Control representative works with the contractor from the time raw material is received until the final product is completed. This is accomplished by "surveillance" type of quality control, using AMC Manual 74-21, "Procurement Quality Control Plan." This plan provides for a systematic appraisal of all contractor aspects related to the quality of the product.

In contrast, during World War II days, as many end items were checked

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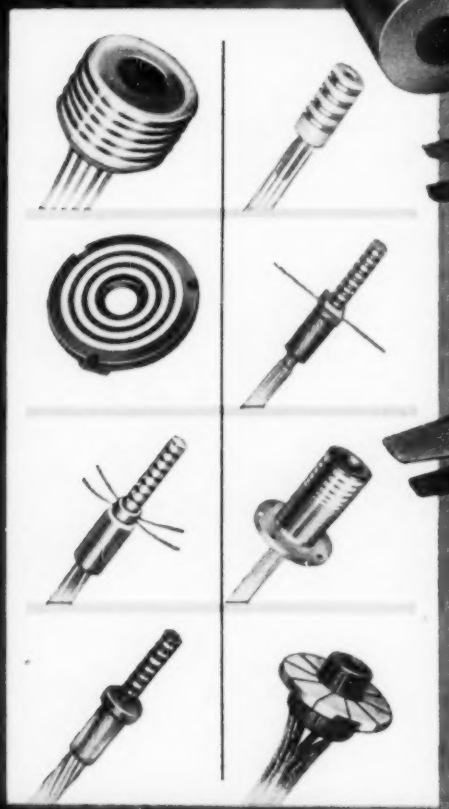

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as available manpower permitted. This method involved the use of an inspection force of 14,000 and limited quality assurance to those items inspected.

In larger plants, the Air Force has resident inspectors, their number varying from one to 70. Covering small plants are itinerant Air Force Quality Control Representatives, each of whom is responsible for a number of plants.

The cost of new procurement inspection amounts to $1.80 for each $1,000 worth inspected.

▶**Double Check**—Work of the inspector—called the backbone of the Quality Control System—in turn is inspected by a survey team once or twice a year. The survey team makes facility evaluation surveys to determine the effectiveness and efficiency of the AF Quality Control organization.

The staff office at Headquarters, Air Materiel Command, has charge of integrating the quality control program in the procurement, supply, and maintenance of materiel. This office also provides technical assistance and guidance in matters of quality control to other Government agencies. The staff office is subdivided into three offices, which handle plans, operations, and quality analysis, and three technical divisions: Aircraft and Weapons, Equipment, and Technical Methods. These divisions direct the field activities from a technical viewpoint.

▶**Technical Methods Division**—Supervision of quality control operations over material processes, precision measuring equipment, petroleum, chemicals, technical data, and packaging, is the job of the Technical Methods Division.

The division's Materials and Packaging Branch controls the quality of basic materials such as aluminum, magnesium, and copper alloys, steels, plastics, ceramics, coatings and compounds, and methods for corrosion control, preservation, and packaging.

It also supervises inspection and test methods, including chemical analysis, X-ray, and ultrasonic inspection. Another area of its work includes quality control of fabricating processes. Also the branch has charge of the inspection and acceptability of technical data, including maintenance handbooks, illustrated parts catalogs, cargo loading data, etc.

The Petroleum and Chemicals Branch oversees the quality aspects of fuels, lubricants, chemicals, and related services. This branch also provides technical direction for the continuous quality control of worldwide aviation fuel and lubricating oil supplies used by the Air Force.

Quality control of tools, gages, and testing equipment is the responsibility of the Precision Equipment Branch. It develops systems for the control and calibration of precision measuring and


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Vitro has recently completed new test ranges and engineering facilities at the Air Force Armament Center, Eglin Field, Fla., and is now engaged in the engineering of instrument systems and the operation and maintenance of test ranges.

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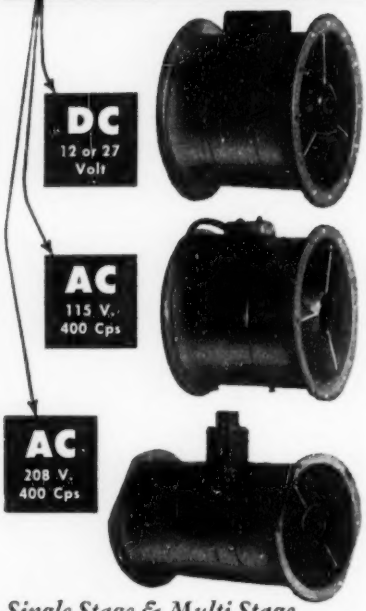


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testing techniques to provide inspection adequacy.

► **Equipment Division**—In charge of quality control for ground and airborne aeronautical equipment is the Equipment Division. Its commodities include photographic, rubber, plastic, textile, and electrical equipment, instruments, ground handling equipment, vehicles and all types aircraft engines.

The Propulsion Branch has responsibility for quality control over acceptance, modification, overhaul, and storage of aircraft engines and engine components.

Quality control of equipment ranging from electrical supplies to prefabricated hangars is the work of the Equipment and Accessories Branch.

The Instrument and Photographic Branch is in charge of the quality control of instruments, of airborne recording and photographic equipment.

► **Aircraft and Weapons Division**—Quality control of aircraft, guided missiles, armament, and electronic equipment is the responsibility of the Aircraft and Weapons Division.

The division's Armament Branch has quality control of armament, the Electronics Branch of electronics equipment, and the Aircraft Branch of aircraft and guided missiles.

## Sampling Speeds Engine Inspection

A statistical sampling plan for aircraft engines, now being used by the Air Force, is saving millions of dollars annually.

The plan is based upon the long-recognized fact that even 100% inspection involves some small risk that a defective engine will be accepted. Quality Control at Air Materiel Command Headquarters has set up the sampling procedures which require inspection of only a percentage of the engines without increasing the risk of accepting a defective engine.

► **Big Savings**—Is the plan working? Air Force's answer is an unequivocal "Yes." USAF contractors using this plan expect a dollar saving of $3,513,773 for 5,728 jet engines produced under the procedures of this statistical sampling plan for aircraft engines. This estimate was based on overall savings of 35,000 man-hours per year on a one-out-of-two basis, 57,000 man-hours on a one-out-of-four basis, and 69,000 man-hours on a one-out-of-10 basis.

Fuel savings are estimated at 630,000 gal. per year on a one-out-of-two basis, 944,000 gal. on a one-out-of-four basis, and 1,134,000 gal. on a one-out-of-10 basis.

Other savings chalked up were due to reduction of engines in process on assembly floor and in parts which must be replaced at every engine teardown, such as gaskets, plugs, seals and lockwiring. Also, fewer parts must be replaced due to damage in disassembly or reassembly.

► **Old Way**—Until the Air Force developed a streamlined acceptance inspection plan, it had been standard practice to run all newly-built engines in a test cell for about two hours.

The engine then was taken apart and the parts inspected for signs of excessive wear. The contractor would correct any defects and the engine was assembled and run for two more hours. If the final test run showed the engine met all the required performance characteristics, the Air Force inspector accepted it.

The expense of this system is apparent. Besides the time consumed, it required test cells to run every engine twice, men needed to operate the cells and inspect the engines, and quantities of fuel.

► **New Way**—Bascially, the new plan adopted by Air Force provides for a reduction in the number of engines given a thorough inspection. After an initial qualification period, during which the manufacturer demonstrates he is producing at a satisfactory quality level, the disassembly and retesting of all the engines is reduced to one-half the number, one-quarter or one-tenth, based upon the quality level which the engine manufacturer is maintaining.

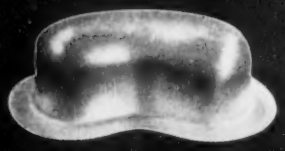
This quality level is determined from those engines which are disassembled and retested. All engines, however, continue to be completely tested for performance characteristics at least once.

The plan is modeled on Dr. H. F. Dodge's continuous sampling plan, in which the risk is called the "average outgoing quality limit." The Air Force's plan, however, is a triple-level plan providing for reductions to the 50, 25 or 10% inspection level based upon the manufacturer's established quality level.

The statistical sampling plan for aircraft engines is not a rule of thumb. It is a statistically sound sampling plan which shows the Air Force inspector whether a manufacturer is producing engines of the desired quality. If the engines are of lower quality, the plan assures that the contractor will revert quickly to larger samples or to 100% inspection until the quality improves.

The idea of applying sampling techniques to aircraft engine acceptance inspection was conceived early in 1951 by Air Materiel Command. The concept later was developed and refined by the Air Force in conjunction with Navy's Bureau of Aeronautics. After six months of combined efforts, a statistical sampling plan acceptable to both services was agreed upon.

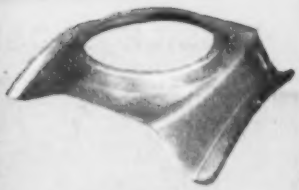
By the end of 1951, the plan was put into operation in an East Coast engine plant on a trial basis. As a result of the



One operation
0.064" 24SO Aluminum

One operation
0.051" 24SO Aluminum

One operation
0.064" 61SO Aluminum



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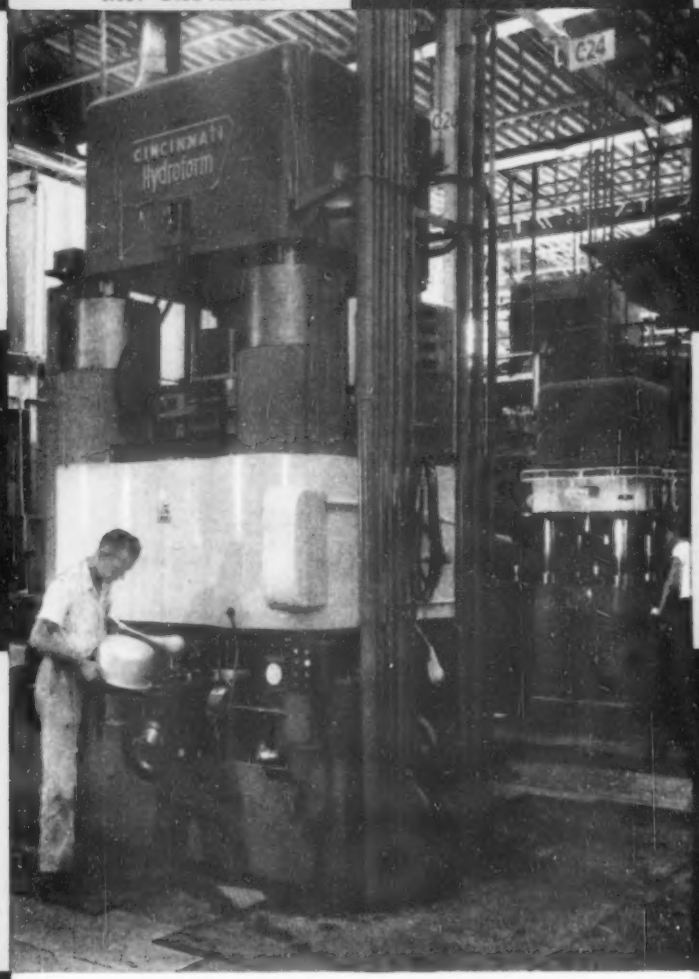
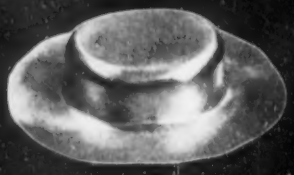
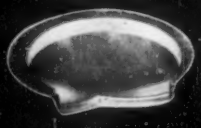
One operation
0.040" 75SO Aluminum



One operation
0.025" RC70 Titanium



One operation
0.051" 61SO Aluminum

◀CINCINNATI HYDROFORM MACHINES AT NORTH AMERICAN AVIATION, Inc. 26" machine in foreground, 12" machine in background. For a description of the Hydroforming process and specifications of the 8", 12", 19", 23", 26", and 32" machine sizes, write for Bulletin M-1759-3.

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Two operations
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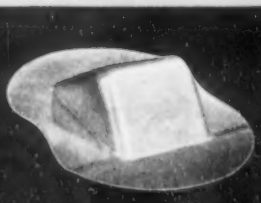

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experience gained in this trial, several improvements were made in the plan and early in 1952 it was published in its present form.

The first jet engine plant was qualified for reduced inspection under this plan in May 1952. At the present time, five plants are fully qualified and are operating effectively on the plan.

The statistical sampling plan is an example of AMC's efforts to reach these objectives: To obtain more production, better quality and lower cost in the supplies it buys for the Air Force.

## AFR 23-2 Defines AMC's Mission

The following states the basic mission, organization and responsibilities of the Air Materiel Command as spelled out in Air Force Regulation 23-2—the authority under which the Command operates.

▶ **The AMC Mission.** The mission of the Air Materiel Command, consistent with the provisions of Department of Defense directives and specific Headquarters USAF implementing directives, excepting the acquisition, construction, and maintenance of real property, and other matters peculiar to air installations activities covered by separate directives is to:

- Provide overall logistical support for all activities and agencies of the Air Force as well as those additional activities and agencies designated by the Department of Defense which are dependent upon the Department of the Air Force for logistical support, including the Mutual Defense Assistance Program.
- Provide, establish, and control adequate, efficient, and up-to-date systems of procurement, identification, production, quality control, maintenance, transportation and traffic management, and supply and disposal for all aspects of logistics support for complete aircraft weapon systems in, or programmed for, the Air Force inventory.
- Train specialized units for the accomplishment of specified logistic functions in overseas areas and theaters, and provide depot-level specialist training for cadre personnel of air depot wings and designated replacement personnel for overseas air depots as prescribed in appropriate directives.

▶ **Concepts and Principles.** In performing the above-cited mission, the following principles and concepts will be adhered to:

- There is an ever increasing demand upon, and a continuing responsibility throughout, the Air Force for demonstrated sound and economical management of resources and operations. This demand generates from the logistic functional management of funds, pro-


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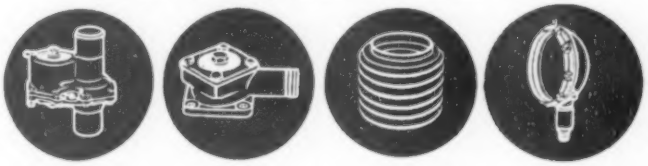

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curement, production, maintenance, supply, and transportation. In logistics, certain managerial data are mandatory; the requirement for such data necessitates and encompasses formal agreements with other Government agencies where procurement is effected for the Air Force, and includes assistance from and coordination with commands such as the Air Research and Development Command. The ready availability of such data as specifications, producibility, drawings (as provided by Air Research and Development Command), production and re-order lead time; actual versus scheduled deliveries; unit costs, status of commitments, and the obligation and expenditure of funds are all prerequisites to sound and economical materiel management. The overall management responsibility for all materiel and services acquired for the Air Force is assigned to the Air Materiel Command. This responsibility includes the economical utilization of equipment.

• Certain authorities in connection with the above-cited overall management responsibilities and procurement authorities are delegated to other major air commands, that is, procurement of highly technical research and development items within the provisions of Air Force policy and regulatory and statutory limitations.

• As a general policy, procurement is a logistic function. The responsibility for acquiring all materiel and services used by the Air Force is that of the Air Materiel Command, regardless of the assignment or delegation of certain procurement authority to another service.

• The logistic function throughout the Air Force requires checking, with Air Research and Development Command, new designs from the standpoint of producibility and ease of maintenance and modification of materiel for in-service use; producing materiel in accordance with qualitative specifications; meeting quantitative requirements, insuring routine quality control of materiel in quantity production and maintenance of materiel for in-service use. The responsibility for these functions is assigned to the Air Materiel Command.

• Active collaboration, cooperation, and coordination must be maintained among representatives of the interdependent development, logistic, and operational agencies (Air Research and Development Command, Air Materiel Command, Air Proving Ground Command, and the other major air commands) to insure the maximum effective use of Air Force materiel, equipment, facilities, and services.

• Any proposal which would cause an appreciable deviation from approved standards or a deviation in qualitative performance, operational characteristics, production schedules for materiel items other than aircraft and engines, or operational availability of materiel in production or service will be considered jointly by the Commander, Air Materiel Command, the Commander, Air Research and Development Command, the commander of the primary using activity, and the Commander, Air Proving Ground Command, as appropriate. In those instances where general agreement cannot be reached or where the decision is of such importance as to warrant the approval of the Chief of Staff, USAF, recommendations reflecting operational, logistic, and technical considerations will be forwarded to the Chief of Staff, USAF for approval or resolution. Pending a decision on the recommendations, the original status or conditions existing prior to the proposal will remain unchanged. Proposed revisions to aircraft and engine schedules which involve changes of program quantities, monthly production rates, and model changes will in all cases be submitted to Headquaters USAF for approval. Instructions to contractors implementing changes to USAF-approved aircraft and engine schedules will not be issued by Air Materiel Command until approval of such changes is obtained from Headquarters USAF.

• To have a continuing source of technically qualified cadre personnel for air depot wings and replacement personnel for designated positions in overseas air depots, training and experience in areas peculiar to those types of operations must be provided. The responsibility for implementing this function is assigned to the Air Materiel Command.

• Federal cataloging and standardization, policy, plans, and programs as governed by the Defense Cataloging and Standardization Act (P.L. 436, 82d Cong., (AFBul 22, 1952)), implemented by Department of Defense and Department of Air Force directives will be accomplished and maintained according to Air Force assignments and commitments. Uniform item identification, cataloging data, and the maintenance thereof are prerequisites to successful and effective standardization of programs, operations, and materiel management. United States Air Force catalog policies, plans, and programs designed to support and serve the Air Force logistic operations and supply management requirements will be maintained according to Air Materiel Command responsibilities, assignments, and commitments.

▶ **Organization.** The Air Materiel Command is established as a major air command.

To carry out its mission, functions, and the provisions of directives and the policies of the Chief of Staff, USAF, the Air Materiel Command is provided with a headquarters and such units, establishments, facilities, and personnel considered necessary by the Com-

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mander, Air Materiel Command, and approved by the Chief of Staff, USAF.

► **Responsibilities.** The Commander, Air Materiel Command, will:

• Exercise command jurisdiction over all units, establishments, facilities, and personnel assigned or attached to the Air Materiel Command.

• Be responsible to the Chief of Staff, USAF for performing the following functions:

(1) Acting as the overall central acquisition and/or procurement and contracting agency for all materiel required by the Air Force.

(2) As sole head of a procuring activity, exercising staff surveillance over procurement activities of other major air commands to which procurement authority has been delegated.

(3) Coordinating and cooperating with other services and other Government agencies in the procurement through those services or agencies of Air Force required materiel. On all materiel funded by the Air Force but procured by another service under cross-servicing agreements, the Air Materiel Command will be the point of contact for the Department of the Air Force on all matters incident to procurement functions, except on specifications approval which is the responsibility of Air Research and Development Command. In addition, Air Materiel Command will, in coordination with the other services, consummate agreements which will insure that data on other service-procured materiel is available to the same extent as for Air Force directly procured materiel.

(4) Implementing approved production programs, including production scheduling, allocation of production facilities, production control, quality control during manufacture of materiel, inspection and acceptance, and the initial custody and control of all materiel procured by the Air Force for which the Department of the Air Force has assigned procurement responsibility, except in those cases where procurement authority has been delegated to another major air command. When procurement authority is delegated or assigned to another major air command, the Commander, Air Materiel Command, will establish the systems and procedures applicable to the accomplishment of the above-stated functions by the other major air command.

(5) Maintaining on a current status: Production capabilities under normal and mobilization conditions; unit costs, production and re-order lead time; providing contract termination data as may be required; and providing procurement program data in groupings of items in terms of Controlled Materiels Plan (CMP) allocation (materials) dollar value or end-item quantitative requirements as directed by the Department of Defense, in accordance with designated program areas. In conjunction with the procuring agencies of the other services, obtaining from, and providing to those services approved procurement data on Department of the Air Force or the Departments of the Army and Navy funded materiel.

NOTE: The responsibility for representation and direct participation on other Service Materiel Allocation committees as established by Department of Defense directives is an inherent responsibility incident to the foregoing, except when the performance of such functions is a part of procurement authority delegated to another major air command.

(6) Preparing plans and developing facilities and resources to meet production requirements, including the maintenance of current and complete logistical data on all materiel funded by the Air Force to provide a basis for timely and appropriate Air Force logistical planning.

(7) Conducting or supervising factory acceptance testing and depot and modification center testing, except when these functions are a part of procurement authority delegated to another major air command. When these functions are a part of the procurement authority delegated to another major air command, the Air Materiel Command will collaborate in factory acceptance, modification, and service testing.

(8) Providing complete managerial data on all materiel and services funded by the Air Force and acquired through Air Materiel Command actions on a current basis. The data to be thus maintained includes but is not specifically limited to:

(a) Air Force direct procurement actions; actual unit costs; schedules of deliveries; actual versus scheduled deliveries; production and re-order lead time by item or category of items as appropriate; funds status, including obligations, commitments, and expenditures; and appropriate backup data supporting requirements for all additional funding when necessary.

(b) In conjunction with the procuring agencies of the other services, obtaining from and providing to those services procurement data on Department of the Air Force or Departments of the Army and Navy funded materiel.

(c) Headquarters-directed modification programs; actual prime equipment costs; schedule of deliveries; actual versus scheduled deliveries; periodic report of work progress; and funds status, including obligations, commitments, and expenditures.

(9) Providing adequate training support in money, personnel, and equipment as new items in Government-furnished aeronautical equipment (GFAE) become available and are installed in the


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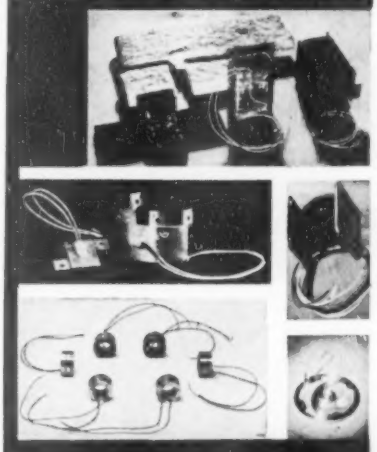

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air frame and/or other major end items.

(10) Maintaining a system which will accurately reflect the current status of all reparable assets and which will insure appropriate recognition thereof in developing requirements involving procurement action.

(11) Scheduling reparable assets into depot and/or commercial facilities for prompt repair and return to the Air Force logistics system as necessary for programmed requirements, giving consideration to the full utilization of wing base capabilities (military and/or local civilian economy resources for contractual maintenance.

(12) Performing transportation and traffic management functions for the movement of materiel for which Air Materiel Command has responsibility and delegated operational transportation and traffic management functions for the Air Force.

(13) Computing requirements for all materiel required by the Air Force based upon program data provided by, or as directed by, the Chief of Staff, USAF, to include all requirements for MDAP or other assistance programs for which the Air Force has Department of Defense designated responsibility.

(14) Providing the required detailed substantiating and backup data, including the verification of the mathematical accuracy of the requirements computations for budget estimates and proposed procurement programs for all materiel for which preparation responsibility has been, or is delegated by the Chief of Staff, USAF.

(15) Providing budget estimates and requesting appropriated funds for a particular fiscal year sufficiently in advance of the approved buying program date to take into full consideration the total buying time (lead time) required to procure an air frame, engine, or any item of equipment.

(16) Preparing personnel and facility requirements, plans, programs, and budget estimates in connection therewith in accordance with prescribed policies and directives.

(17) Implementing Headquarters USAF directed materiel and logistical programs and projects and periodically advising the Chief of Staff, USAF, of status and progress.

(18) Establishing and implementing a procedure covering all the Air Materiel Command actions necessary to make available to the Air Force at programmed dates complete aircraft weapon systems (airframe, propulsion, guidance and control, armament and required test, ground handling, maintenance, and support equipment).

(19) Maintaining a program and a system of uniform item identification cataloging criteria essential for the effective support and accomplishment of the Air Force logistical and supply manage-

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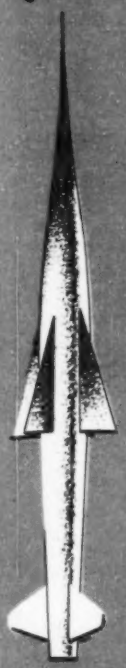

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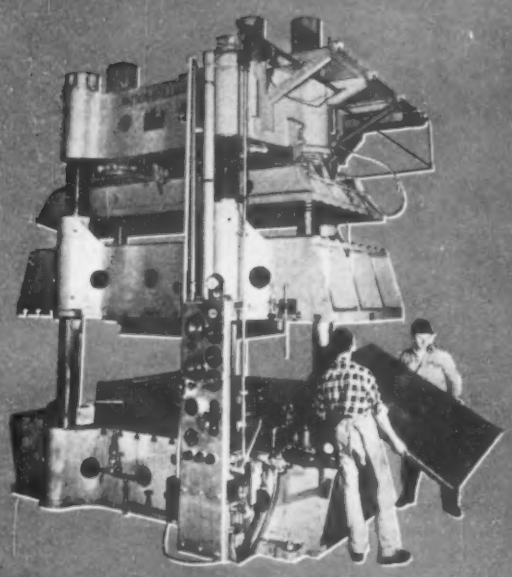

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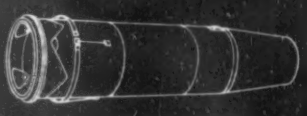

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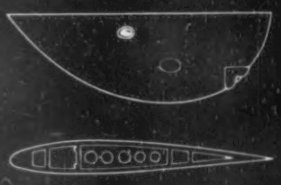

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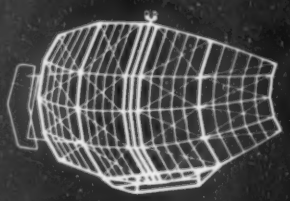

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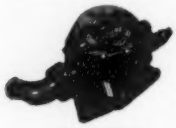

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ment mission objectives and commitments.

(20) Compiling, prescribing, publishing, and distributing Air Force-wide supply catalog data. Participating with industry, other major air commands, the Departments of the Army and Navy, and other appropriate agencies in the collaboration and exchange of information on matters pertaining to cataloging. Providing a uniform supply cataloging organization system, including operations, and data in consonance with the concepts and principles for the successful accomplishment of the multiple functions and objectives of supply management.

(21) Determining substitutes and interchangeability in collaboration with the using commands and engineering review agencies (ARDC) for maximum utilization and conservation of Air Force materiel resources. This includes adaptation of design to economical quantity manufacture and the choice and improvement of manufacturing process incident thereto, provided that the qualitative military capabilities of the materiel are not changed. Interchangeability of parts and modification of fabrication processes are in this category.

(22) Maintaining technical direction and staff supervision in accordance with Air Research and Development Command approved design criteria over the Air Force packaging and materiels handling program; establishing and implementing claim prevention programs.

(23) Determining and/or recommending approval for the authorization of the type, quantities, and/or basis of issue of organizational and individual equipment required by Air Force activities; establishing and maintaining a system for authorizing such equipment for Air Force activities, including changes proposed by the major air commands to the Master Equipment Authorization List (MEAL), Unit Property Record and Equipment Authorization List (UPREAL), and Unit Allowance List (UAL), and Base Allowance List (BAL), with recommendations for approval, disapproval, or alternate action to Headquarters USAF. Compiling, publishing, and distributing Air Force-wide Equipment Component Lists (ECL's) prescribing individual tool kits and sets of equipment for a specific type of functional operation, such as paint shop, machine shop, and so forth, and Tentative Tables of Equipment (TTEs) to support new types of piloted and pilotless aircraft.

(24) Providing Wright Air Development Center (through ARDC) with Buyer's Guide listing of materiel on which procurement is to be effected for verification of specifications prior to preparation of Purchase Requests and/or Military Interdepartmental Purchase Requests.

(25) Utilizing data required and available for its operation, together with data submitted by other major air commands, and compiling and editing, from a technical standpoint, the USAF Logistical and Planning Manual.

(26) Making continuing effort to obtain the maximum effectiveness from all resources available to the Air Force, including the establishment of a system which will reflect accurately the current status of materiel reserves within and available for the Air Force logistic system.

(27) Directing and performing the Air Force depot level of supply operating functions to accomplish the receipt, distribution, storage, issue, and stock control of Air Force materiel, including Army, Navy, or other Federal agency procured materiel for which the Air Force has storage and issue responsibilities, within the zone of the interior; and providing supply technical direction and assistance, as required.

(28) Providing depot level maintenance within the zone of interior on Air Force materiel; providing for depot level maintenance within the zone of interior on material procured by other departments for the Air Force or by the Air Force for other departments, in accordance with interdepartmental agreements.

(29) Compiling, prescribing, and/or publishing and distributing Air Force-wide standard methods and procedures in technical publications for the maintenance and operation of all materiel in the Air Force system. This includes a managerial requirement for a cooperative and mutually agreed upon participation, as necessary, with other major air commands, such as Air Research and Development Command, other services and Government agencies performing a development, supply, and/or service function for the Air Force to insure the availability of specifications, drawings, and other data required.

(30) Administering as well as continually improving the Unsatisfactory Reports system to provide better and more expeditious support to the Air Force. This will be done in coordination with Air Research and Development Command and other major air commands as required.

(31) Providing installation engineering for, and the installation of, fixed communications - electronics facilities and equipment; assisting Air Training Command, when requested, in the training of installation-engineering, installations, and maintenance personnel for these systems.

(32) Planning, engineering, and installing adequate and up-to-date base internal wire and telephone systems at all Air Force bases and installations within the zone of interior, including the establishment, augmentation, and/or

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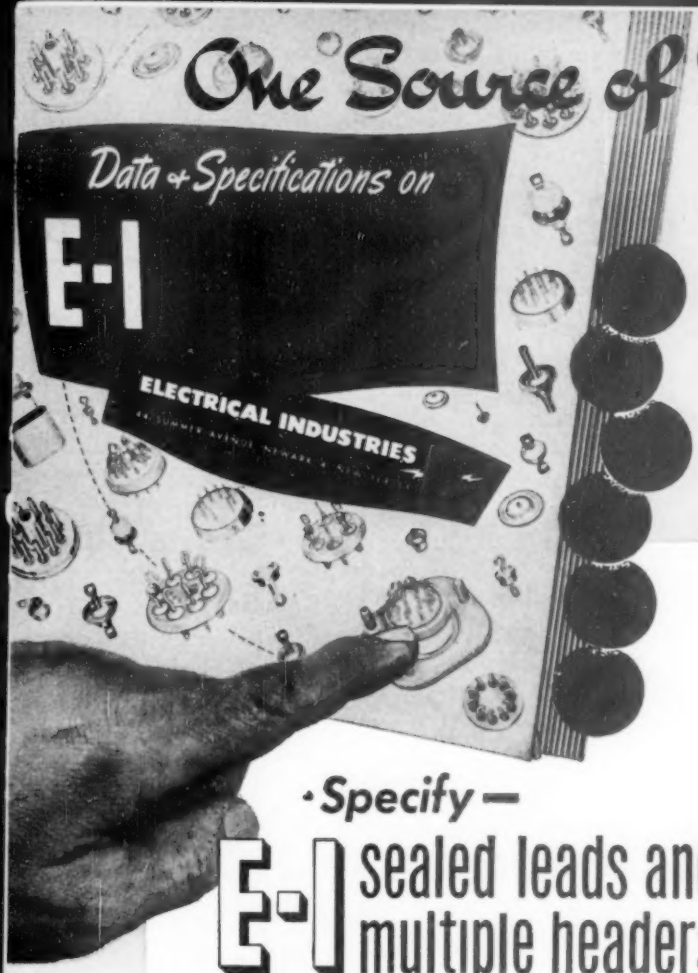


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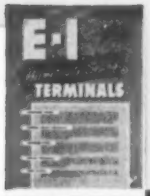


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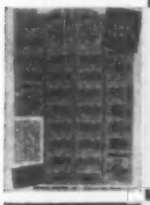

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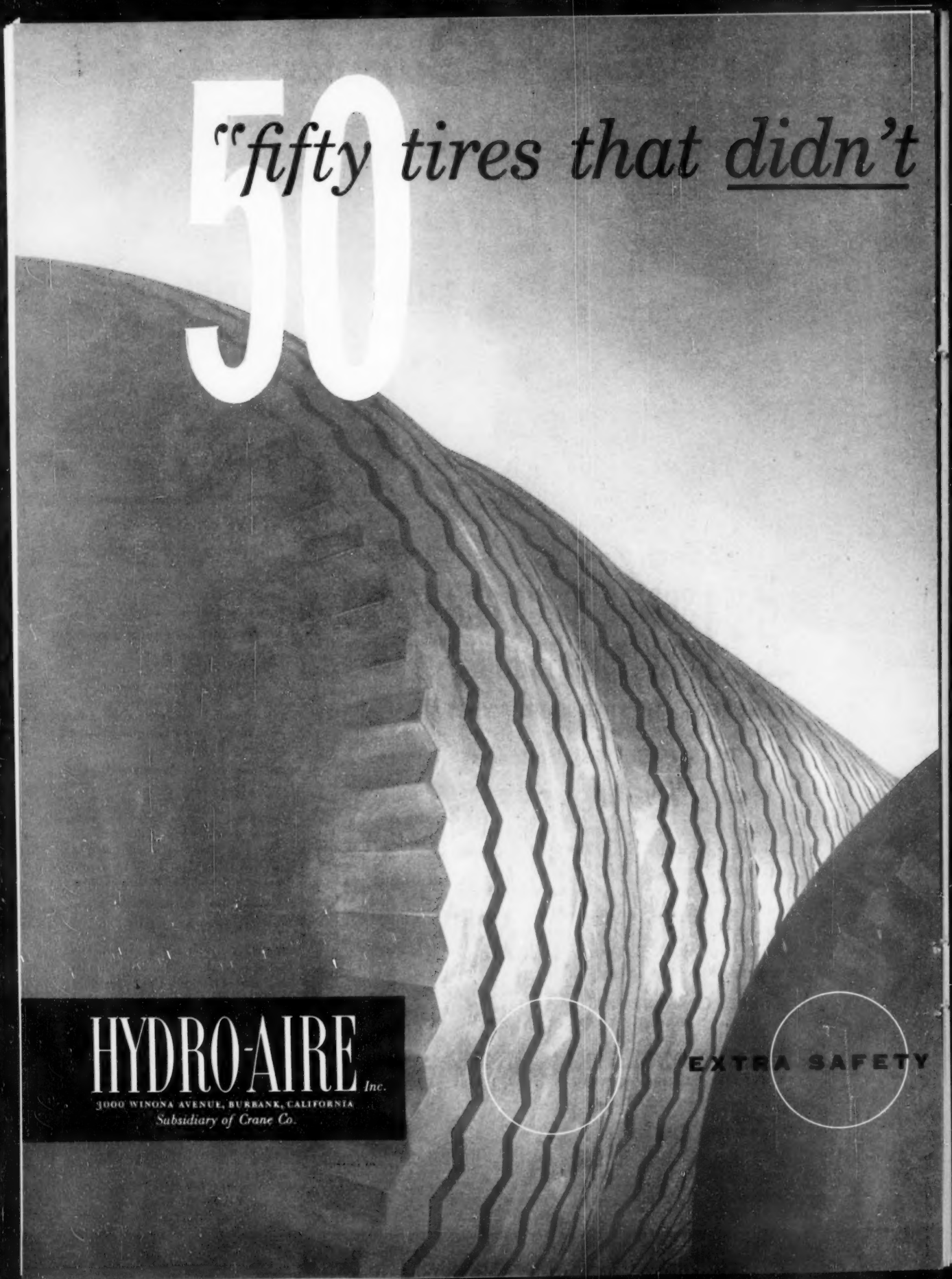
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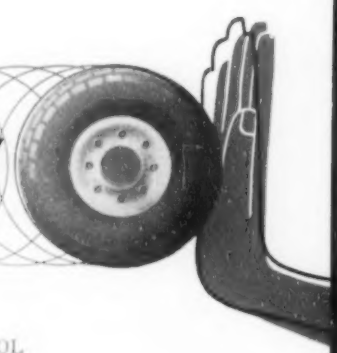

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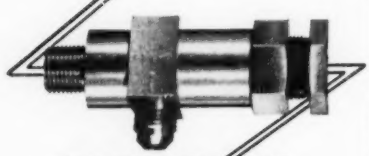

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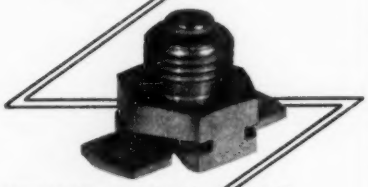

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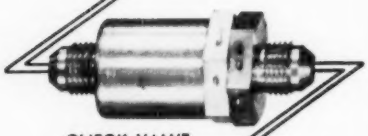

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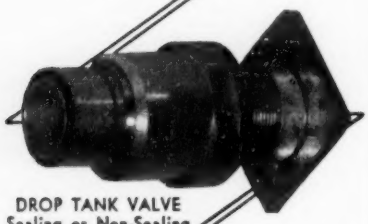

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rehabilitation of such systems.

(33) Prescribing the maintenance, including the systems, methods, and procedures therefor, to be performed at depot, organization, and field levels.

(34) Providing maintenance technical assistance to the Air Force, as required.

(35) Providing maintenance-engineering support to the Air National Guard, Air Force Reserve, and Civil Air Patrol, as required.

(36) Organizing, training, equipping, and preparing for overseas movement specified service units.

(37) Training depot-level specialists in appropriate skills, practices, and procedures for cadres of air depot wings and as replacements for designated individuals in oversea air depots.

(38) Providing specialist training and experience, above that provided by the Air Training Command, for communications-electronics maintenance and construction cadre personnel of specialized communications-electronics units as well as designated replacement personnel for these units overseas.

(39) Participating in the Reserve training program to the maximum possible extent commensurate with the execution of the Air Materiel Command mobilization mission by exercising the responsibility for the training of Reserve officers and airmen as may be directed by Headquarters USAF, and by training and administering such Reserve units as may be assigned.

(40) Providing the facilities and organizations required to accomplish special weapons responsibilities assigned to the Air Materiel Command.

(41) Effecting prompt disposition of all scrap and salvage material in accordance with existing directives.

(42) Assisting other responsible Air Force activities and agencies with the collection and evaluation of foreign aeronautical information and equipment as directed.

(43) Participating in disaster relief and other domestic emergencies as required of and/or by the major air command designated for coordinating such activities.

(44) Participating in exhibits, commemorations, and so forth, as authorized.

(45) Keeping the Chief of Staff, USAF, informed on the progress of the materiel and logistics program, and reporting to him at least once a year concerning the effectiveness of the command.

## Ground Rules for Air Weapons Systems

Here are the ground rules under which USAF and the aircraft industry operate to develop new aerial weapons systems, their supporting systems and sub-systems, as spelled out in Air Force Regulation 70-9.

► **Definitions.**

• **Weapon System**—An instrument of combat such as an air vehicle together with all related equipment both airborne and ground based, the skills necessary to operate the equipment, and the supporting facilities and services required to enable the instrument of combat to be a single unit of striking power in its operational environment.

• **Supporting Systems**—A system composed of techniques, skills, and equipment, the composite of which is not an instrument of combat but which is in support of an operational role or mission. Examples are: weather, air-sea rescue, logistics, intelligence, and training systems.

(Throughout the Regulation, the term "Supporting System" may be substituted for the term "Weapon System.")

• **Major Subsystem**—Major functional part of a Weapon System which is essential to operational completeness. Examples are: airframe, propulsion, armament, navigation, and communication.

• **Government-Furnished Property (GFP)**—Property in the possession of, or acquired directly by the Government, and delivered or otherwise made available to the contractor.

• **Government-Furnished Aircraft Equipment**—That portion of Government-furnished property which under the terms of an Air Force air vehicle contract is procured and furnished by the Air Force directly to the air vehicle contractors for inclusion in air vehicles.

• **Contractor-Furnished Property (CFP)**—Property other than Government property used by the contractor in the performance of a contract.

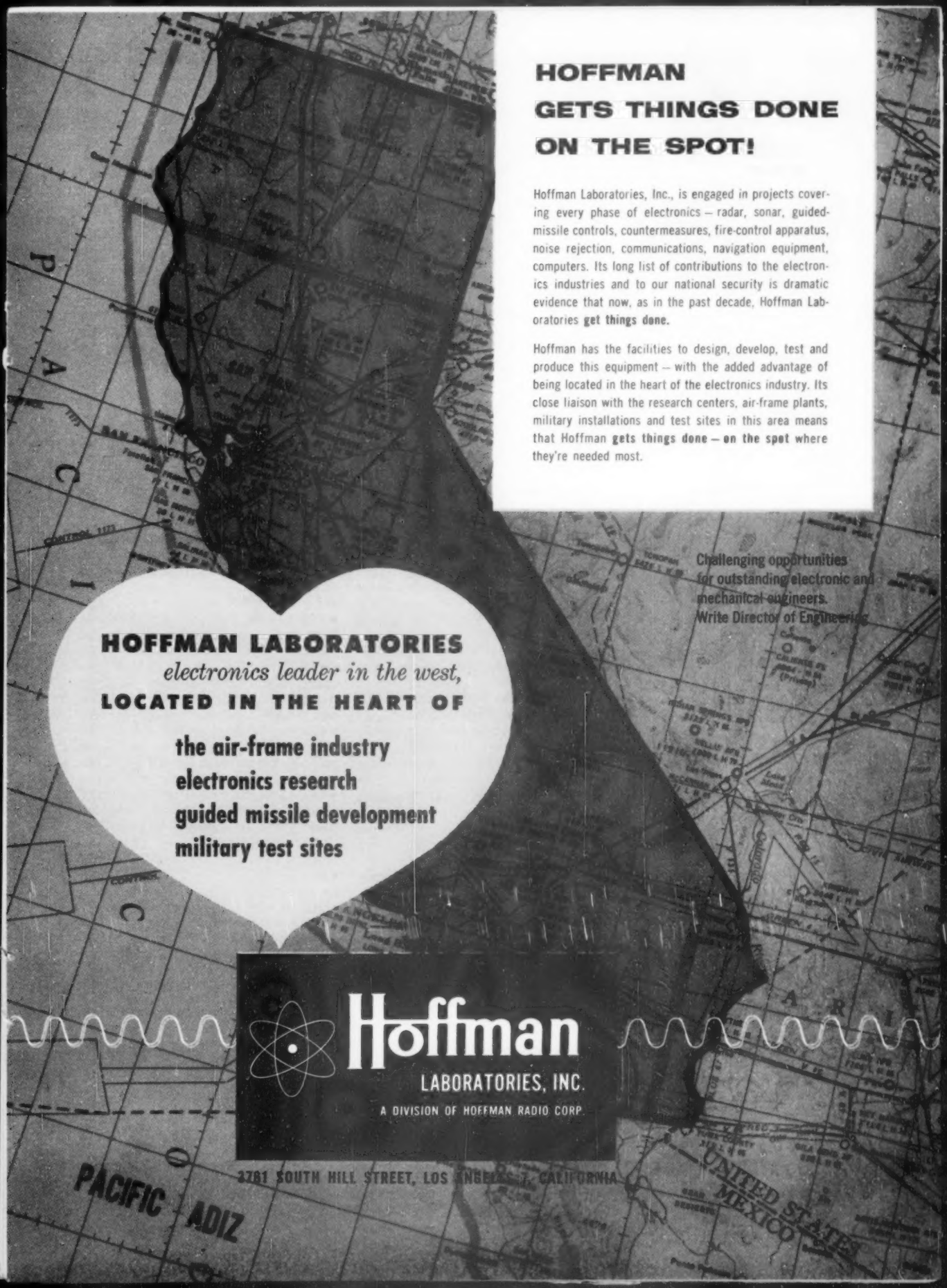
• **Contractor-Furnished Aircraft Equipment (CFAE)**—That portion of contractor-furnished property which is included in the air vehicle by the air vehicle contractor.

• **Issue Items**—Air Force items which are essential to Weapon Systems but which may be furnished to an Air Force agency for installation in, use with, or the support of the air vehicle. Examples are: Stowed life rafts, sextants, drift meters, fuel trucks, crash trucks, first aid kits, personnel parachutes, oxygen masks, aircrew clothing.

• **Weapon System Development**—Engineering studies, design, and development necessary for the integration of Major Subsystems, component equipment, support equipment, and applicable Issue Items, so the composite fit and operate together in a compatible manner as required for an effective Weapon System.

• **Prime Contractor**—A contractor having a direct contract with the Air Force.

• **Weapon System Contractor**—A Prime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• **Associate Contractor**—A Prime Contractor to the Air Force for the development or production of items or equipment meeting specifications prepared by another contractor and as approved by the Air Force.

▶ **Policy.** The following Air Force policies are stated for the guidance of all agencies and organizations:

• Owing to the increased technical complexity of present day aircraft and equipment; the increasing necessity of obtaining compatibility and integration of the various equipments within a Weapon System; and the ever present necessity for expeditious, orderly, and economic conversion from the development phase to the production phase, the normal practice for the Air Force will be to accomplish Weapon System Development through Weapon System Contractors.

• Since the advantages and disadvantages of utilizing different methods of procuring development and production vary with the type of equipment, Major Subsystems and components considered, the normal practice for the Air Force will be to procure the development and production of a Weapons System as shown in attachment.

• Sufficient control will be established and maintained by the Air Force to insure that:

(1) A vigorous and healthy equipment industry will be maintained.

(2) A proper industrial base in the equipment industry is maintained to provide for rapid production expansion in the event of mobilization.

(3) Only reasonable profits and costs are allowed.

(4) Government recognized standards are used to the maximum practicable extent.

• Owing to the long development time which must precede Weapon System production, a continuing program of Research and Development will be maintained by the Air Force, independently of Weapon System Development, in order to insure orderly, balanced, and continuing progress in studies, research and Major Subsystem, component equipment, and Issue Item development.

▶ **Responsibilities:**

a. Air Materiel Command will procure Weapon System Development and will select contractors for production.

b. Air Research and Development Command will maintain close surveillance of all engineering aspects of Weapon System Development.

c. Air Materiel Command will maintain close surveillance of procurability, producibility, maintainability, and other logistic factors during the progress of Weapon System Development and during production.

▶ **Procedures:**

• The Air Materiel Command and the Air Research and Development Command will procure development and production of Weapon Systems as described herein. Deviation from this procurement procedure can be made if AMC and ARDC jointly determine that a good and sufficient reason exists for such deviation, after conducting a review of the specific conditions in the particular case, such as: unique technical aspects of the system, the time schedule involved, the status of Air Force developments, and the capacity and capability of the particular contractors being considered.

• Air Research and Development Command will monitor development of Major Subsystems, insuring that development of their internal parts is avoided when GFAE or standard Air Force equipment is available, or under development, and will be satisfactory for use without compromising effectiveness of the Weapon System.

• Air Research and Development Command will approve the design, qualification test, and installation data for all items.

• Air Materiel Command will include provisions in contracts with Weapon System Contractors providing for Air Force approval of equipment developments and production which are accomplished directly by the Weapon System Contractor under the procedure of category I of attachment. In contracts for the development and production of Weapon Systems, provisions will also be included for Air Force approval of subcontracts for equipment procured by the procedure of category I of attachment. In the above-cited approvals, consideration will be given, but not be limited, to:

| | *(Primary Responsibility)* |
|---|---|
| (1) Selection of equipment | ARDC |
| (2) Selection or approval of specification | ARDC |
| (3) Standardization of equipment | ARDC |
| (4) Qualification testing of all items prior to production delivery | ARDC |
| (5) Approval of subcontract source | AMC |
| (6) Type of subcontracts | AMC |
| (7) Price and profit | AMC |
| (8) Patents and license rights for equipment | AMC |
| (9) Quantity of equipment on subcontract | AMC |
| (10 Timely delivery of technical data | AMC |
| (11) Timely delivery of procurement and production data | AMC |

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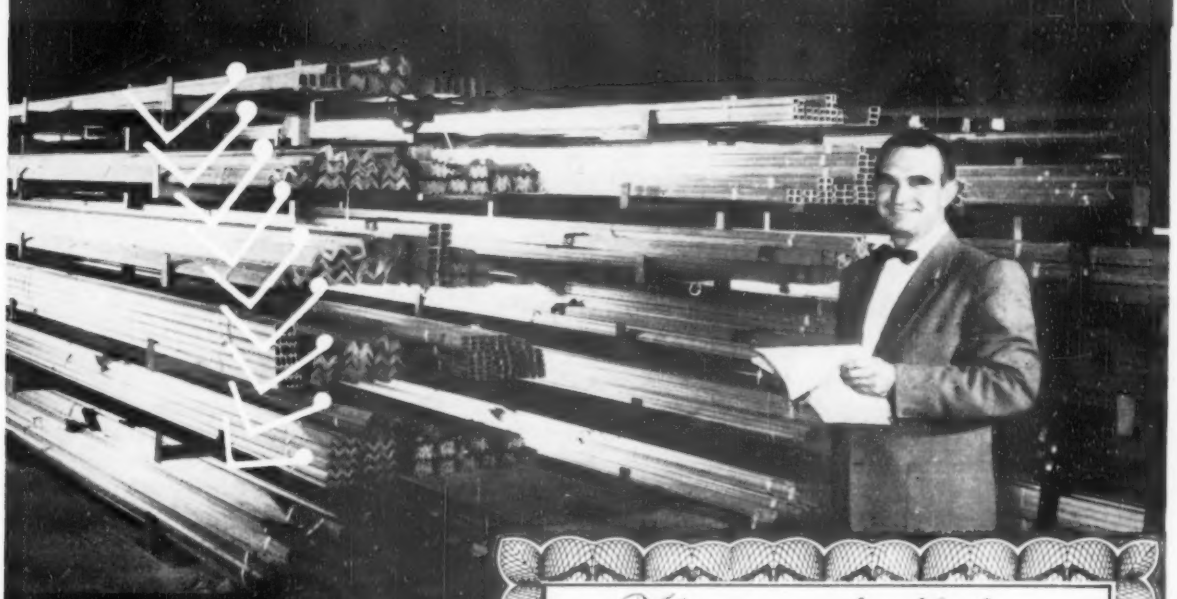

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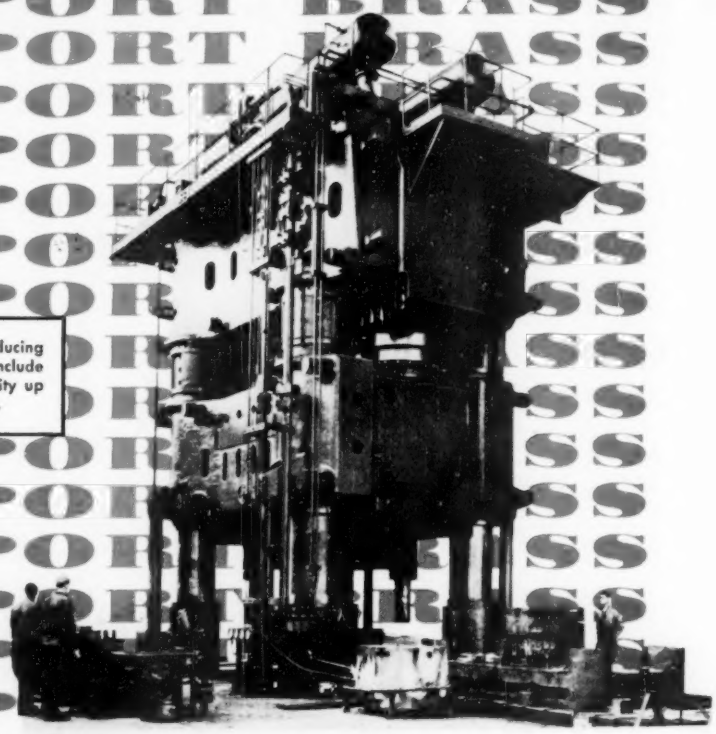

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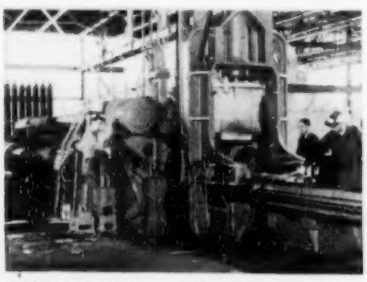

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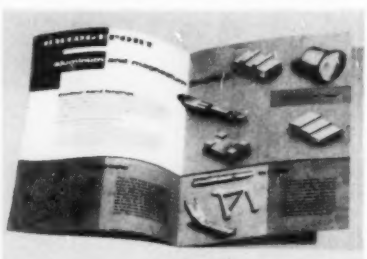

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(12) Type and location of Government-owned facilities ..... AMC
(13) Timely placement of subcontracts ..... AMC

• For each weapon system, Air Research and Development Command will establish and maintain, so far as practicable, a list of all equipments in the different categories shown in attachment. At the time the budget is prepared, Air Research and Development Command will furnish to Air Materiel Command such lists for all Weapon Systems in the given fiscal year program. Also, ARDC will inform AMC of all changes to such lists.

## AMC Glossary

As in all large organizations, the use of abbreviations is thoroughly exploited by Air Materiel Command. Knowing them helps greatly in dealings with AMC personnel. Here are a few:

ACO–Administrative Contracting Officer
AF–Air Force
AFB–Air Force Base
AFM–Air Force Manual
AFPP–Air Force Procurement Procedure
AFPR–Air Force Plant Representative
AGO–Adjutant General's Office
AMA–Air Materiel Area
AMC–Air Materiel Command
APD–Air Procurement District
ARDC–Air Research and Development Command
ASPR–Armed Services Procurement Regulation
CFE–Contractor Furnished Equipment
CO–Contracting Officer
CPFF–Cost Plus Fixed Fee
DD–Department of Defense
DN–Directorate Notice
DOI–Directorate Office Instruction
FCR–Facility Capability Report
FP–Fixed Price
GFAE–Government Furnished Aircraft Equipment
GFP–Government Furnished Property
HOI–Headquarters Office Instruction
IG–Inspector General
IFB–Invitation for Bid
JAG–Judge Advocate General
MDAP–Mutual Defense Assistance Program
PR–Purchase Request
QC–Quality Control
RFP–Request for Proposal
SDPA–Small Defense Plant Administration
TM–Technical Manual
TO–Technical Order
WADC–Wright Air Development Center
WPAFB–Wright-Patterson Air Force Base


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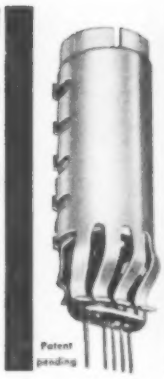


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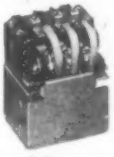
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☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

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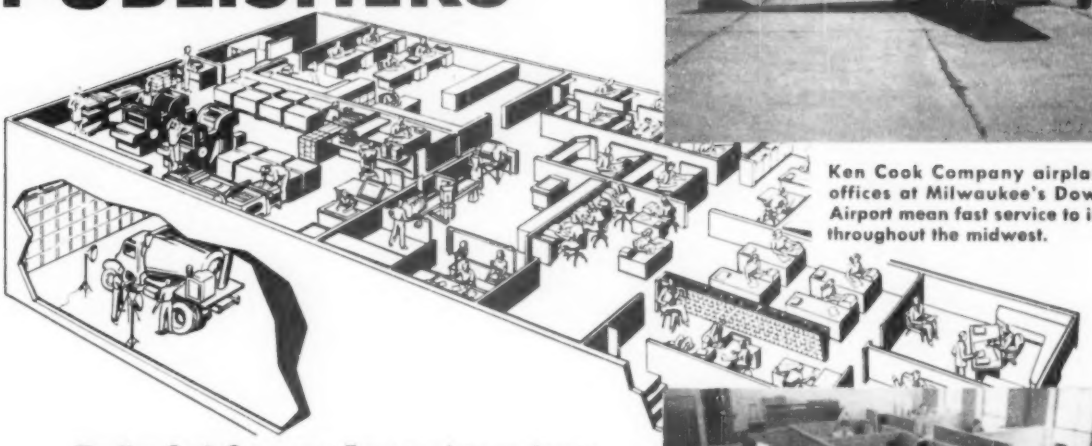

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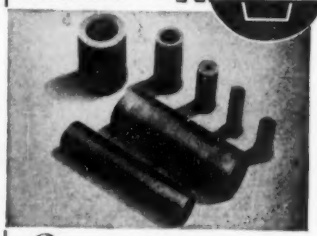

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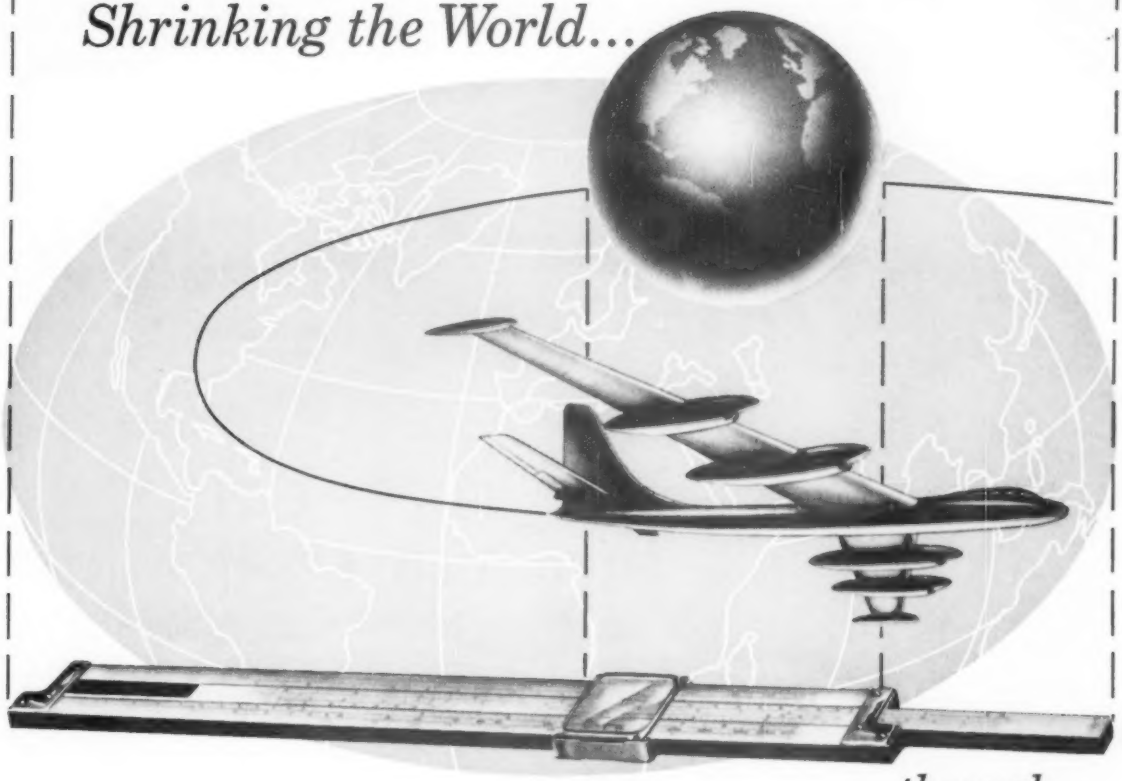

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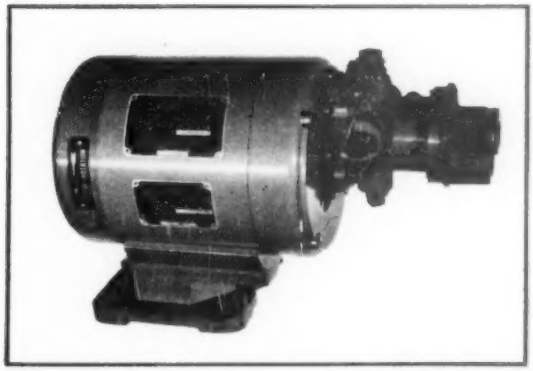

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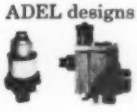

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## NEWS DIGEST

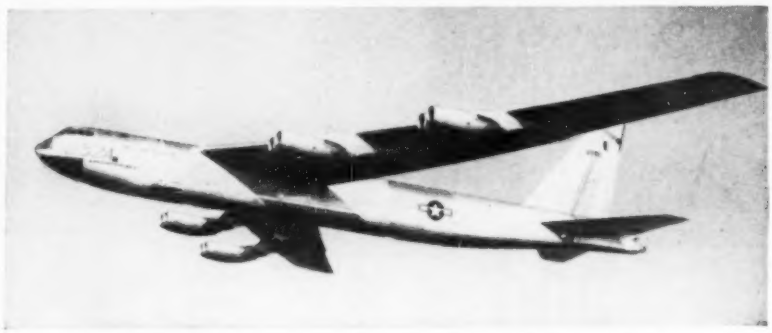
# CAP Picks up Option On 37 Viscounts

Capital Airlines last week exercised its option with Vickers-Armstrongs to purchase 37 turboprop Viscount transports and, at the same time, obtained an option for an additional 20.

Capital already has purchased three Viscounts (AVIATION WEEK June 14, p. 16). With the additional 20, CAP would have 60 turboprop transports, thus replacing its entire present fleet.

Delivery on the original 40—a contract worth $45 million, according to CAP president J. H. Carmichael—will commence early in 1955 and is to be completed by August 1956. Delivery on the balance, should the new option be exercised, will be accomplished between September 1956 and February 1957, Vickers reports.

By exercising its option on the original 37, Carmichael said the airline would be able to inaugurate service at the earliest possible date. The Viscount will be put into first service on Capital's routes next April, he said.



**First Production Stratofort Goes Aloft**

**Eight-jet Boeing B-52A Stratofortress is airborne during its first flight Aug. 5. This is the first production model of an undisclosed number of Stratoforts being turned out for Strategic Air Command at Boeing-Seattle and also slated for phasing in at Boeing-Wichita. Powered by 10,000-lb.-thrust-class P&WA J57s, the B-52A grosses more than 175 tons.**

## Domestic

**Protest strike** of 1,243 American Airlines pilots, called over extension of the eight-hour nonstop flight rule, continued last week with no solution in sight. AA president C. R. Smith notified the Air Line Pilots Assn. members they were suspended effective July 31. Another American spokesman said the company reserves the right to stop seniority and to terminate employment of the strikers.

**U. S.-British agreement** to collaborate on guided missile development includes a list of projects that will get top attention, reports U. K. Minister of Supply Duncan Sandys. He does not identify the projects but makes it clear the two nations will do more than exchange information.

**Fairchild Engine & Airplane Corp.** will build a new powerplant production factory and a turbine test lab on a 200-acre site at Deer Park, N. Y. The new facility will replace Fairchild's Farmingdale engine plant, sold recently to Republic Aviation Corp. (AVIATION WEEK Aug. 9, p. 7).

**Maj. Gen. John W. Sessums, Jr.,** will become vice commander of Air Research and Development Command Sept. 7. He will succeed Maj. Gen. James McCormack, Jr., who has been reassigned to USAF Headquarters as Director of Research and Development in the office of the Deputy Chief of Staff for Development.

**Maj. Gen. Herbert B. Loper** (U. S. Army, Ret.) has been appointed assistant to the Secretary of Defense for atomic energy and chairman of the military liason committee to the Atomic Energy Commission. He succeeds Robert LeBaron.

**Walter Sternberg** has resigned as president of Resort Airlines, will handle sales development as a consultant. Harold L. Graham, Jr., is new Resort president.

**Arthur L. Caperton,** 56, airline operations specialist for Civil Aeronautics Board and retired American Airlines pilot, died Aug. 5 at Alexandria, Va.

**Maj. Charles E. Yeager,** first pilot to fly faster than sound, has been detached from USAF's flight test center at Edwards AFB, Calif., and reassigned to 12th Air Force Headquarters, Ramstein AFB, Germany, as a staff operations officer.

**Corporal guided missile** battalion, the 259th Field Artillery, will be sent to Europe in the near future and assigned to the U. S. units operating with North Atlantic Treaty Organization forces.

## Financial

**Boeing Airplane Co.,** Seattle, reports net earnings of $17,349,618 for the first half of 1954, compared with $9,178,473 for the first six months of last year. Sales totaled $496,861,262, an increase of $77,921,875.

**Chance Vought Aircraft, Inc.,** Dallas, had a net income of $1,916,906 for the quarter ended June 30, compared with $1,293,000 for the previous three months of 1954. Sales increased from $35,329,162 to $42,337,478. Backlog June 30: approximately $283 million.

**United Air Lines** will sell $20 million in new 20-year Series C 3.75% debentures Sept. 10 to Metropolitan Life Insurance Co. and Mutual Life Insurance Co. of New York. UAL also has reduced its standby bank credit from $45 million to $30 million and extended the term of availability to Dec. 31, 1955.

**Reaction Motors, Inc.,** Rockaway, N. J., plans to increase authorized capital stock from 130,000 to 500,000 shares and split outstanding stock at a two-for-one ratio. The proposal will be submitted to stockholders at a special meeting Aug. 26.

**Kaman Aircraft Corp.,** Bloomfield, Conn., reports business volume for the first half of 1954 has increased 128% over the same period of last year.

## International

**Avianca Constellation 749** crashed into a mountain peak on Terceira Island last week as it climbed through fog shortly after takeoff from the Azores on a Hamburg-Bogota flight. All 30 persons aboard were killed.

**Scandinavian Airlines System** has won its trans-polar route from Copenhagen to Los Angeles on a three-year experimental basis, granted under a new amendment to the U.S.-Scandinavian (Norway, Sweden and Denmark) bilateral air agreement. Tentative inauguration date: Nov. 15.

# Stretchout Called Aid to Industry

## Saltonstall tells Senate the Administration's airpower program will sustain 'vigorous' aircraft production.

The Administration's "long-pull" airpower program was staunchly defended by Sen. Leverett Saltonstall, chairman of the Armed Services Committee, as emphasizing "quality rather than mere quantity" of weapons and a "stable supporting manufacturing industry."

A major portion of his full-dress floor speech was devoted to the Administration's explanation of lagging obligations for aircraft procurement (AVIATION WEEK July 26, p. 10). USAF estimated an unobligated balance of $4.49 billion as of July 1, the start of fiscal 1955. In January, the estimate was $1.8 billion.

▶ **Difference Exists**—Saltonstall said the Administration's air program now has the "wholehearted backing of all Air Force personnel . . . and is being rapidly implemented and loyally supported from top to bottom of the defense organization."

Pointing to opposition that flared up a year ago when USAF's budget was cut $5 billion from the Truman Administration recommendation, Saltonstall commented: "Although criticism . . . appears to have subsided, a major difference in viewpoint still exists"—namely, whether it should be pushed "on a crash basis regardless of cost, regardless of efficiency and regardless of the effect on our mobilization base" or whether it should be a long-term effort.

The senator said reports on Russia's progress on intercontinental guided missiles, made recently in a Senate speech by Sen. Stuart Symington (AVIATION WEEK Aug. 2, p. 13), "underline the urgency of this program. They do not demonstrate that less is being done than can practicably be accomplished or realistically aimed at."

Saltonstall added: "Intensive work is being done to hasten the development of pilotless missiles and other weapons of the future. What is being done and what is being aimed at do not in the slightest fall short of the attainable because of any failure to provide the necessary funds."

▶ **R&D Need**—At the same time, Symington, in an address at Arnold Engineering Development Center at Tullahoma, Tenn., repeated his call for a greater defense effort in aviation research and development and missiles.

"With potential aggressors constantly gaining new outposts on the world's surface and the intercontinental ballistic missile constantly growing toward reality," he declared, "our danger daily becomes greater. . . . That we are moving too slowly is fact. We can and must move faster. . . .

"The Kremlin is overtaking us in research and development and in some respects, are known to have surpassed us," Symington said, objecting that the present Administration "has recommended a smaller R&D appropriation for USAF each year."

▶ **'Improbable' Target**—Saltonstall supported the Administration program—aimed at 137 wings by 1957, compared with the Truman program for 143 wings by mid-1955—on four main grounds:

- It is "entirely improbable" the Truman target could have been met, and an attempt to meet it "would have seriously reduced the overall combat effectiveness of USAF."

He questioned that 26 new wings could have been activated in a single year to meet the 1955 date. Cadres for the nuclei of the new wings would have to be drawn from existing wings, a development that would have had "a major effect on USAF's combat effectiveness," he said.

- The "long-pull" program "reduced the pressure on the Air Force to accept equipment with less than the desired performance characteristics."

By allowing adequate time for "orderly development, testing, production and integration into the force," Saltonstall maintained, "it should do much to eliminate the endless rounds of modification of equipment after it is delivered and the resulting extra costs and delays."

Production difficulties during the past year, he said, have been narrowed to a few aircraft.

He itemized: F-86 output temporarily was delayed by a strike at North American Aviation; "long-standing difficulties" with the B-57 and F-84F "are now being overcome"; the only other problem combat airplane is an anti-submarine warfare plane; helicopter production problems "involve only one major model."

- Under the Administration program, "economy and efficiency need no longer be sacrificed for speed."
- It has enabled USAF to plan for "sustaining a vigorous aircraft manufacturing industry. Had the original 143-wing program been possible," Saltonstall said, "an early production peak followed by a sudden and drastic reduction in aircraft production to the point of practically closing down the industry could not have been avoided."

# 707 Pays off, Winds up in Ditch

## Boeing's jet Stratotanker wins USAF contract: four hours later it is damaged when brakes fail.

**Seattle**—Boeing Airplane Co.'s $15-million gamble on a jet transport paid off Aug. 5 and then wound up in a drainage ditch.

Boeing president William Allen picked up a telephone after lunch and received some welcome news from the Pentagon: Air Force was announcing a production order for the Stratotanker—the order Boeing gambled on when it decided to build a jet tanker transport with its own money.

Four hours later, while Boeing executives still were celebrating the Air Force announcement, president Allen received another phone call. With chief test pilot A. M. (Tex) Johnston at the controls, the brakes on the 707 failed as the big jet swept into a landing at Boeing Field at dusk.

▶ **Sharp Swerve**—As the 707 neared the end of the 10,000-ft. runway, Johnston kicked it into a sharp swerve to the right hoping to make a 180-deg. turn and head back up a nearby taxi strip. He almost made it.

But as the yellow and brown prototype of the U.S. entry in the jet transport field bumped over the rough grass, the nose wheel smashed across a drainage ditch and into a concrete block. The gear sheared off and the 707 skidded 40 ft. on its nose.

It could have been worse. The only damage to the fuselage and wings seemed to be a few dents in the underside of the aircraft. The pods never touched the ground. But it would delay flight testing of the big plane at least 30 days while a replacement for the snapped oleo was turned out.

It was the second landing gear delay for the 707. During taxi tests prior to its maiden flight, the main gear buckled and delayed the first flight two months.

▶ **Frozen Moisture?**—Boeing technicians last week were at work trying to determine the cause of the brake failure. Early reports of a hydraulic failure proved incorrect. Johnston reported that he had full hydraulic pressure on both the dual braking systems in the 707 at the time of the accident.

One theory: Rapid descent from high altitude might have frozen moisture somewhere in the braking system.

The Boeing jet was well into its flight test program when the mishap occurred. At the time of the accident, it was carrying ballast that brought it close

to its design landing weight.

Boeing officials, despite the landing gear trouble, still were enthusiastic over their new aircraft. It already had passed the 550-mph. estimate for cruising speed.

Worried lest its ground troubles hang a jinx label on the first U.S. jet transport, one Boeing spokesman commented: "If we could only figure out a way to leave it up in the air."

► **Tooling Cost Plus**—Air Force released no details on its production order for the Boeing jet tanker. But the contract was expected to cover cost of tooling for production plus whatever number of aircraft could be built with the money left over after setting up the assembly line. In the case of the B-47A, this turned out to be 10 aircraft.

Boeing executives also were wondering just what leeway the USAF contract would allow them in accepting orders from U.S. airlines for jet transports. For there was no doubt that the Air Force order gave Boeing another big boost in the race for airline orders—despite a simultaneous USAF announcement that its design competition for a jet tanker would continue.

Most ironic touch in the situation came in a paper delivered at the Institute of the Aeronautical Sciences meeting on turbine-powered air transportation here last week by John E. Steiner, project engineer of Boeing's preliminary design team. Its title: "Stopping Large Jet Airplanes."—**WJC**

## USAF to Show B-52 At Dayton Air Show

Boeing's long-range B-52 jet bomber will be demonstrated to the public for the first time at the National Aircraft Show in Dayton, Ohio, Sept. 4, 5 and 6. In addition to a static display, USAF crews will stage a flyby of the B-52 each day of the show.

Other daily events at Cox Municipal Airport, Vandalia, will include:

- Arrival of 12 B-47 jet bombers on training flights from England.
- Interception of B-29 bomber by three F-94 Starfires and a C-121C radar picket plane. The interceptor pilots will scramble and demonstrate how early warning radar is used by the Air Defense Command.
- Precision flying demonstration by USAF Thunderbirds and Navy Blue Angels.

Eleven pilots, led by Maj. Fred Blesse, Korean ace, will open each performance with sonic boom dives over the crowd.

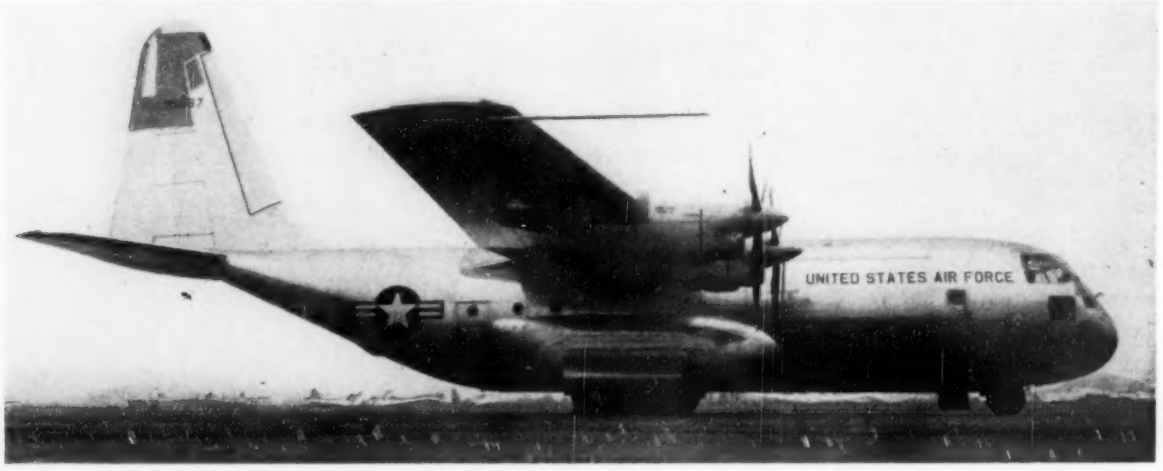
Navy and Marine aviation programs were not complete last week. The tentative schedule calls for flyby of F3H, F7U and FJ-2 fighters, a demonstration of HSL helicopter and an aerial refueling exhibition by AJ-2 and F3H. There is a possibility that the Navy's application of boundary layer control to improve carrier plane performance will be demonstrated.

The Army plans to show how lightplanes are utilized by troops in the field, and last year's popular helicopter square dance will be repeated.

Major trophy events will be:

- Sept. 4, Bendix Trophy race, speed dash from Edwards AFB, Calif., to Dayton.
- Sept. 5, Allison Trophy event for scramble and interception of B-29 bomber; General Electric Trophy race, 500 kilometers.
- Sept. 6, Thompson Trophy race, 100 kilometers.

In all, 175 USAF planes will take part in the show. Nearly 100 commercial exhibits will be set up in airport hangars to display latest equipment of aviation industry firms.



## Lockheed Rolls Out Turboprop YC-130

**Flight tests are expected to begin soon on new Lockheed turboprop YC-130 transport for USAF at Edwards AFB, following rollout at Burbank, Calif. Quantity production of C-130A is assigned to Lockheed's Marietta, Ga., plant. Allison YT56s, each delivering 3,750 hp., turn three-blade Curtiss props. Plane spans 132 ft., will carry up to 20-ton loads. Low-slung fuselage has a floor at truck-bed level; upswept fuselage permits rear-end loading. Tandem main wheels retract upward into streamlined bulges that leave fuselage area clear for cargo. Dual nosewheels are used.**

## ACC Backs Doolittle Airport Proposals

Air Coordinating Committee has approved recommendations of the Doolittle Airport Commission on airport safety with the exception of a proposal to certificate airports.

Major recommendations:

• **Expand federal-aid program.** Highest priority in the application of federal aid should be given to runways and their protective extensions. Participation, ACC says, would be concentrated upon airports of national interest with essential types of construction.

• **Support required airport development.** New airports will be needed and present airports must be improved. State, county and municipal governments should be prepared to assume their proper share of this expense.

• **Maintain positive air traffic control.** Certain air traffic control zones in areas of high air traffic density should be made subject to special regulations to insure that all aircraft within the zone are under positive control at all times, regardless of weather.

ACC says this subject has been under discussion within the committee but that Civil Aeronautics Administration has lacked funds, personnel and electronic equipment to carry out the program at the present time.

• **Raise circling and maneuvering minimums.** Present straight-in instrument approach minimums are considered satisfactory, but the minimum ceilings and visibilities under which aircraft are permitted to circle or maneuver under the overcast in congested terminal areas should be raised.

Commerce Department concurred with the recommendation to the extent of minimizing circling and raising circling minimums where safety dictates.

• **Extend use of single runway system.** New airports should adopt a single or parallel runway design. This should be adequate except under strong wind conditions, in which case a shorter runway at 90 deg. to the main one may be required.

Present airports should plan to develop the dominant runway at the expense of those less used. Airport expansion should be achieved through additional parallel runways. Commerce Department agreed with the recommendation provided a single runway will yield 95% coverage with a 15-mph. crosswind component.

Other recommendations were concerned with airport safety goals and did not deal with controversial subjects.

Commerce Department and CAB did not concur in the recommendation to certificate airports, since the objective sought by the recommendation can be achieved under existing authority. Objectives sought by the commission:

• To make certain that all major airports would conform to defined minimum safety standards.

• To prevent major airports from being arbitrarily closed or abandoned.

The review procedure assigned responsibility for carrying out the recommendations. Most of the changes can be made without additional legislation with the notable exception of securing federal funds for airport aid.

The ACC group reviewing the Doolittle conclusions was composed of: Joseph D. Blatt, CAA, chairman; D'Arcy Harvey, CAA; William B. Becker, Air Transport Assn.; Capt. I. L. Dew, Navy; Col. Clifford Dougherty, Air Force and Robert Froman, CAB.

## Thye to Fight 'Chosen' International Airline

An Administration supporter, Sen. Edward Thye, has given a "warning sign" that he will fight establishment of a "chosen instrument" for international aviation, reportedly being promoted on grounds of economy by "certain people in high positions of government."

"This policy has been rejected upon numerous occasions in the past by the executive and the legislative branches of our government," the Minnesota senator said in a floor speech. "Many assumed that it was a dead issue."

▶ **ACC Policy**—The following statement from Air Coordinating Committee's report on civil air policy, he added, indicates that "the new drive for the chosen instrument policy will be based upon the grounds of economy":

"National interest factors require that many international routes be maintained despite subsidy requirements. Route decisions in this area should recognize the necessity of avoiding or eliminating uneconomic duplication of service between U. S. carriers."

Thye said he is concerned specifically with possible elimination of Northwest Airlines' Orient route, in which case "all U. S. flag carrier operations in the Pacific would be monopolized by Pan American Airways."

▶ **'Destroy Competition'**—The chosen instrument policy, Thye protested, "would serve to destroy free competition in a vital segment of our economy. This system of free competition has brought out the finest of man's ingenuity and is a basic part of our nation's success. We must not destroy that which has contributed so much to the productive and progressive economy which we enjoy."

During the post-World War II fight that dragged on for several years, the "chosen instrument" was aggressively advocated by Pan American and supported by United Air Lines. All other carriers strongly opposed it.

## Tom Braniff Crash Blamed on Wing Ice

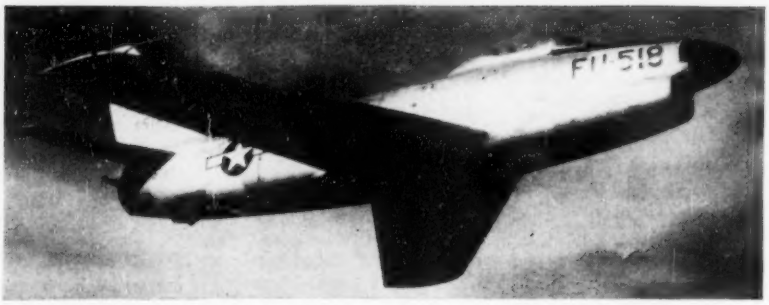
Rapid accumulation of wing ice is cited as the probable cause of the crash Jan. 10 of a Grumman Mallard that killed 12 persons including Thomas Braniff, founder and president of Braniff Airways (AVIATION WEEK Jan. 18, p. 20).

Pilot's failure to acquaint himself with the pertinent weather forecast was called a contributing factor in the Civil Aeronautics Board accident investigation report.

The plane, owned by the Union Producing Co. of Shreveport, La., crashed approximately 10 mi. south of Shreveport, La., while carrying a hunting party.

**African Airline Orders Turboprop Viscount**

Central African Airways is the latest airline to order the Vickers-Armstrongs Viscount turboprop transport. CAA has signed a contract for five Model 700D Viscounts, similar to those Capital Airlines is getting next spring. CAA's order is valued at $4.2 million, including initial provision for spares. This brings total Viscount orders to 106.



**F-86D SABRE** overhaul program already has begun and a similar plan for . . .

**F-94C STARFIRE** modification is scheduled to get under way early next month.

# USAF to Modify F-86D, F-94C

## Sabres are moving onto lines for airframe, engine and fire control changes; Starfire to begin Sept. 1.

**Los Angeles**—U. S. Air Force has started a major modification program to improve two of Air Defense Command's three all-weather interceptors—North American Aviation's F-86D Sabre and Lockheed Aircraft Corp.'s F-94C Starfire (see p. 83).

The program will include airframe, engine and fire control changes.

"Project Pullout" (AVIATION WEEK Apr. 19, p. 11) already is under way with F-86Ds moving into a modification line at McClellan AFB, Sacramento, Calif., and at the NAA facility at Fresno, Calif.

F-94C modification known as project "Hop-Up," is scheduled to get under way about Sept. 1.

No similar program is contemplated for the third ADC all-weather interceptor, Northrop Aircraft's F-89D that recently completed a major modification.

▶ **Side by Side**—The program will continue for 18 months until all F-86Ds and F-94Cs have been modified to meet the new requirement. The year-and-a-half schedule was worked out to modify the aircraft as rapidly as possible without endangering the nation's air defenses by pulling too many out of service at once.

More than half of the aircraft will be modified on side-by-side assembly lines of Air Materiel Command's base at McClellan, the Sacramento Air Materiel Area. Lockheed and North American each will modify more than 100 of their own aircraft.

▶ **F-86D Changes**—Completeness of the overhaul may be judged from the manner in which each F-86D will be torn apart during the program. Its intermediate fuselage and wing will be overhauled at Sacramento or Fresno. The aft fuselage will be sent to NAA's Inglewood plant; the E-4 fire control system to Hughes Aircraft, and the autopilot to Lear, Inc.

These are among the F-86D changes:

- Modification of fire control system to improve its performance. Details of this are classified.
- Installation of radar tape system to record radarscope data during flight.
- Modification of flight control system. This is largely a change in the stabilizer control system. Intended to give the pilot a stick force gradient that will vary with stabilizer trim changes at various speeds, the modification is "variable slope feel system." It is a mechanical change.
- Installation of drag chute in the tail, expected to reduce landing roll as much as 40%. A 16-ft., ring-slot type chute will be stowed in a compartment below the rudder and above the exhaust.
- Modification of Lear autopilot. Details of this change also are classified.
- Modification of the F-86D engine to the J47-GE-17B configuration. This includes hot streak ignition system for quicker afterburner lightups as well as control changes designed to ease maintenance problems.

▶ **F-94C Modifications**—The Lockheed F-94C fire control system will be modified during the program, but again security prohibits disclosure of details.

Another of the changes scheduled for the Starfire will bring an enlarged cockpit.

A number of F-94C pilots in the past have complained that the Starfire cockpit was too small for safe ejection.

Latest Lockheed-designed ejection seats are being installed, which Lockheed Aircraft Service says will have many advantages over older-type seats. The new seats provide increased space for both pilot and radar observer, plus a greater design strength for highspeed ejection.

A gas-activated catapult system will insure successful ejection.

The seat includes an automatic safety belt release that opens the lap belt and shoulder harness automatically after ejection.

A Plexiglas windscreen is being installed in the F-94C to protect the radar observer after the canopy is jettisoned prior to bailout. The new seat also includes a heavy steel bar across the head rest to act as a ram to break through the canopy glass if the pilot must eject with his canopy closed.

Telescoping tracks added to the new seats assure that they will be clear of the aircraft upon final release. This minimizes tumbling and also provides positive clearance of the vertical stabilizer after ejection.

In another change the pilot's seat has been made adjustable both fore and aft as well as in height.

▶ **Major Test**—Scheduling of the modification programs has been a major test of AMC's policy of placing responsibility for prime aircraft at the Air Materiel Area level. The Sacramento Air Materiel Area will process some 800 aircraft through its maintenance lines during fiscal 1955, including those of "Pullout" and "Hop-Up."

The Sacramento AMA conferred with Wright Air Development Center, the aircraft manufacturers, Air Defense Command and other operation commands to work out a program to modernize the two aircraft and bring them up to the desired configurations.

"One of the most important phases," says Col. Arthur C. Perry, director of

maintenance at the Sacramento AMA, "was to work out a schedule acceptable to the Air Defense Command on the number of planes which they could release."

▶**Close Support**—In order to overhaul the aircraft in the minimum time, Sacramento worked out a close support schedule with other Air Materiel Areas involved in the program: engines at the Oklahoma City AMA, autopilot systems at Middletown AMA, and fire control at Warner Robins.

To achieve maximum efficiency, the maintenance directorate at McClellan ran a "prototype" of the F-86D modification through its assembly lines before "Project Pullout" was started. A team composed of shop personnel, industrial engineers and production control experts tore the plane apart and compiled a list of all jobs that could conceivably come up during the overhaul.

This data then was used in planning the assembly line that would modify the aircraft. —WJC

## Aircraft Holds Lead As Biggest Employer

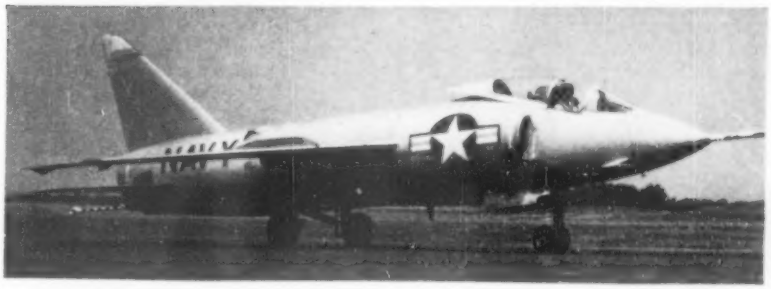
Aircraft industry continued to lead the automobile industry during April as the nation's largest manufacturing employer despite a drop of 6,500 workers from March employment statistics (AVIATION WEEK July 5, p. 15). During the same period, the automobile industry loss totaled 16,800.

April statistics from Department of Labor's Bureau of Labor Statistics show:

- Aircraft and parts industry employed 816,600 persons, compared with 768,500 in automobile manufacturing.
- Average weekly earnings for aircraft and parts production workers was $83.45, compared with $88.10 for automobile workers.
- Weekly hour average was 40.5 for the aircraft and parts industry, compared with 40.6 for the automobile industry; average hourly earnings were $2.06 in the aircraft industry and $2.17 in automobile work.

# F9F-9 Tiger

- **Grumman takes wraps off supersonic Navy fighter.**
- **New jet has 'Coke bottle' fuselage to reduce drag.**



**Peconic River, N. Y.**—Grumman Aircraft Engineering Corp. reached down into its long-unused bag of aeronautical tricks and pulled out a new one: the supersonic F9F-9 Tiger, designed as a jet fighter for the Navy (AVIATION WEEK Aug. 9, p. 11).

In Grumman's first public showing of a new fighter since 1947 (the F9F-2), test pilot H. C. (Corky) Meyer demonstrated the quiet speed of the glistening white plane in a series of blistering low-altitude runs past a crowd of Navy and company officials, the press and news cameras.

Afterwards Meyer commented: "The plane had to be held back for these tests. . . . But we've been supersonic and she gets there with no effort at all."

▶**No Old One**—Although the Tiger carries the designation of the elderly F9F series, it is a completely new design, unrecognizable as a descendant of the rough-and-ready Panther and Cougar. Its indented fuselage lines are an aerodynamic stratagem to reduce drag at sonic speeds. About all Grumman will say is that the fuselage is best described by its nickname of "Coke bottle."

Horizontal tail is extremely thin and is the all-flying type with small-chord elevators, reported to be operational only when gears and flaps are down. It is low-mounted on the fuselage in the style pioneered by North American Aviation in the F-100 as the answer to stability problems of pitch-up at high Mach numbers.

Powerplant of the F9F-9 is a Wright Aeronautical J65-W-7 turbojet rated at better than 7,220 lb. thrust. Afterburning will be incorporated in production models but has not been installed yet on the prototype.

▶**Missile Armament**—The new Tiger will have modern armament, says Grumman, including air-to-air and air-to-ground missiles.

Wings are swept to about the same degree as the Cougar. They are extremely thin, and the entire upper surface is machined from a single sheet of aluminum alloy.

Only a small portion near the wing tip folds upward for storage.

Landing gear retracts into the fuselage, giving it the narrow tread and appearance that characterized the first retractable gear designed by Grumman for its XFF-1 back in 1931.

Grumman has a $40-million contract covering the prototype development and production of the airplane. Production of the Tiger is under way now.

The Navy's attitude is summed up by Rear Adm. Apollo Soucek, chief of the Bureau of Aeronautics. Says Soucek: "Once again, Gurmman has come through when we needed it. . . . We see an even greater and better airplane than Grumman has ever given us before."

—DAA

# An important message to Engineers

from

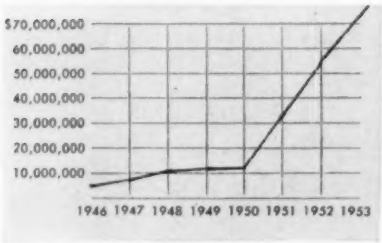
## I. Nevin Palley

*Vice President—Engineering*

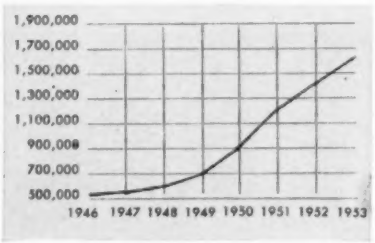
**TEMCO AIRCRAFT CORPORATION**

Your future, like mine, depends not only upon your professional abilities, but upon your choice of the company where you will exercise them.

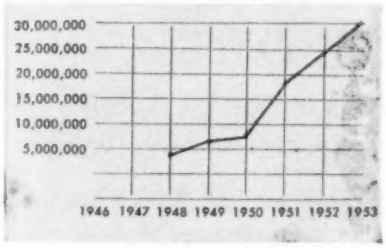
There is one word—familiar to engineers—that perfectly describes our organization and its future: *dynamic.* TEMCO's growth has been remarkable. More important, it has been sound, for it is based on experienced personnel and alert, aggressive management. Here are three growth graphs to quickly illustrate for you what this company's history has been and what its future promises:




**VOLUME OF SALES**




**PLANT AREA GROWTH**

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# CAA Preparing Jet Liner Rules

## Lee tells IAS that changes and standards must be developed as turbine transport facts are established.

Civil Aeronautics Administration will meet and successfully solve turbine-powered transport problems as they arise, CAA Administrator Fred B. Lee told the Institute of the Aeronautical Sciences meeting held at Seattle last week.

"The accomplishments achieved have been noteworthy," he said, "a direct result of active cooperation between industry and government. . . . American ingenuity coupled with cooperation can meet and solve any problems."

▶ **Progress Noted**—As to the airworthiness of the faster airliners, Lee said steady and substantial progress is being made. Changes to rules and standards must be "carefully and progressively developed and modified as the fundamental engineering principles and facts are established," he added. "Standards must assist in holding to and improving the safety record but they must not hamper progress. . . .

"Some of the decisions on airworthiness cannot be long delayed, since upon them will depend fundamental aspects of the aircraft design itself: the location of the powerplants, the size of the spar chords, how much stability, and payload-field size, range relationship and many others."

Main points requiring "sound analysis and early decision," he told IAS, are:

• **Powerplants.** Because of the tremendous amounts of kinetic energy stored in the rotating parts of turbojet and turboprop engines at operating speeds, it can be seen that any major failure of a turbine engine releases its energy with tremendous destructive power.

"Decisions on engine ruggedness, protection and location will be of prime importance to safety," he said.

• **Speeds and loads.** "If our turbine-powered aircraft were designed in a manner similar to today's design practices so that dynamic response characteristics were unchanged and operating practices in terms of cruise speeds and spreads between cruise speeds and rough air speeds also were the same, then our future aircraft would look forward to a safety record strengthwise comparable to our present service record.

"However, since the turbine airplane will differ from our existing aircraft in these respects, a conservative approach to the design speed and gust problem is needed, and close cooperation between industry, CAA, Civil Aeronautics Board and the military services must be maintained."

• **Performance.** An "extremely realistic approach to the complex problem of temperature accountability in turbine-powered aircraft must be employed," since a piston engine loses about 1% power for a temperature increase of 10F, while the turbojet loses about 2 to 3% and the turboprop about 4 to 5%.

• **Safety analysis.** "Experience is a most valuable asset in producing a safe design. . . . We must analyze most thoroughly the aircraft systems, equipment and controls to anticipate everything that could conceivably go wrong and, if the consequences could seriously endanger the aircraft, devise a reliable means of preventing the occurrence or of safely controlling the consequences.

"I have hopes," Lee told IAS members, "that the art and science of safety analysis can become as highly developed as stress, weight and performance analysis."

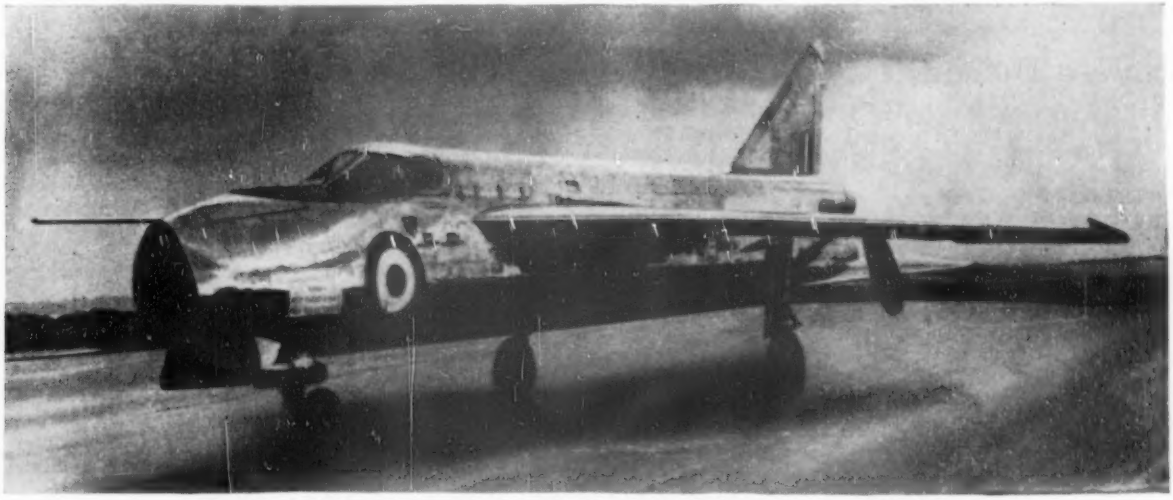
▶ **Airport Problems**—As far as airports for turbine-powered aircraft are concerned, said Lee, "there seem to be very few entirely new problems. Rather, most of these are familiar problems but perhaps now of a more pressing nature."

The CAA Administrator suggested the following recommendations in formulating airport development programs:

• Incorporate cleared runway extension areas into airports.
• Establish effective zoning laws.
• Accelerate installation of aids to air navigation.
• Meet standard requirements for runway length.
• Accelerate ground noise reduction programs.
• Arrange flight patterns to reduce ground noise.

In order to facilitate and expedite terminal operations, Lee recommended the use of parallel runways or other configurations that will permit simultaneous operations and highspeed turnouts to taxiways with clear ground markings and taxiway signs.

To eliminate takeoff delays with



## English Electric Tests Twin-Jet Supersonic Fighter

Britain's Ministry of Supply has ordered prototypes and pre-production models of the new English Electric P. 1 fighter, which the company says is the first plane designed in Britain to achieve supersonic speeds in level flight. First P. 1 made its initial flight Aug. 4 at the MoS test center at Boscombe Down. Powerplants are two Armstrong Sidderley Sapphires of more than 7,200 lb. thrust each. Tailpipes are arranged one above the other. The P. 1 is fitted with a low-mounted "flying tail."

mixed traffic, CAA recommends that well-planned ground holding areas of liberal size should be constructed near the end of runways.

"It has been stated, that jets will not be unduly demanding with respect to runway lengths," said Lee. "Boeing, speaking of the 707, states it will be able to operate from existing airports. Also, it is encouraging to see that reverse thrust mechanism development is being accelerated."

He listed these other problems to be faced in construction of runways:

• Pavement deterioration resulting from engine heat blasts and from fuel spillage on taxiways, parking aprons and the ends of the runways. Investigations are underway to develop materials and methods to overcome this.

"It may be that blast pads or non-traffic bearing ground cover in the form of a lightweight paving may be required for a few hundred feet beyond the ends of runways to prevent erosion due to jet blast," he said.

• "It is not anticipated that jet transport weights will exceed the pavement strengths recommended for the airport service categories," said Lee.

• "Paved areas, in general, must be kept free of foreign particles which can play havoc with jet turbine blades."

▶ **Traffic Control**—". . . In the U. S. today," Lee said, "there are sufficient military jet operations to saturate the airspace between 20,000 and 40,000 feet over wide areas. Therefore, we are rapidly accelerating our efforts toward finding the best possible solutions to the traffic control and operations problems."

Improvements required to control jet traffic, he said, include: better weather forecasting, reliable navaids, and better communications.

## Stassen Defends U.S. Air Aid to Britain

U. S. purchases of British military aircraft were defended strongly by the Administration and condemned on the floor of the Senate following an Appropriations Committee staff report that attacked the offshore buying program (AVIATION WEEK Aug. 9, p. 12).

Harold E. Stassen, Foreign Operations Administrator, told a news conference:

"That report is one of the most inaccurate investigator's reports that I have ever seen. We have followed the policy of the U. S. not buying for NATO purposes any plane that is not evaluated as top flight by our own Air Force. . . ."

▶ **'Intended Dominance'**—Republican Sen. George W. Malone said on the floor:

". . . We have been and are financing Britain's intended dominance over our own aircraft industry and are subsidizing Britain's aircraft builders, while our own industry must rely on money from its private stockholders."

At the same time, a Senate Armed Services Committee report said it now is considering launching a thorough investigation of all aspects of offshore procurement.

Sen. Malone's criticism came when he offered an amendment to the foreign aid bill that would deny help to nations recognizing Red China. The amendment was defeated.

Malone inserted tables in the Congressional Record showing aircraft and equipment purchased by the U. S. in Britain. Total for fiscal 1952: $7.5 million; for fiscal 1953, it was $144.7 million. Biggest purchase in 1953 was $140,074,200 for Hawker Hunters.

▶ **U. S. 'Self Interest'**—". . . The report raises the question," Stassen said, "as to whether we are supporting civil aviation in the United Kingdom. We are not, as far as grants for civil aviation are concerned, and there has been no diversion of our funds for this purpose. It is, of course, true that any time you help build a country's military aviation you automatically help build its civil aviation indirectly.

"Our own aircraft industry gets a great lift from its tremendous military orders. Is that not desirable? Are you going to hold back military jet aircraft development in the U. K. and in France and other free countries because you are afraid of the civil competition with U. S. air companies? Of course not, because you also have the Soviet moving in this field.

"Therefore, as rapidly as we can, and in the self-interest of the United States, we want every possible aviation technical brain in the free world devoted to rapid, effective future development of our modern air strength.

". . . We vigorously defend, in the interest of the U. S., the basic security policy that is questioned in that report."

Malone said: "Whether these funds go into commercial aircraft or not, there will be profits to the British aircraft industry and Britain can put those profits into its race to rule the skies, as Britain once ruled the seas."

## Mickel to New Post

Merlin Mickel, one of the editors of AVIATION WEEK and its predecessor since 1943, has joined the editorial staff of the petroleum group of publications in McGraw-Hill Publishing Co. He was Transport Editor in 1947 when Aviation News and Aviation were consolidated to form AVIATION WEEK. He served as Managing Editor and Administrative Assistant to the Editor at AVIATION WEEK.

## Lockheed Plans Lab For Atomic Weapons

Lockheed Aircraft Corp. has appropriated $10 million to establish a new laboratory that will give heavy emphasis on atomic and hydrogen weapons research and coordinate activities with the company's Missiles Systems Division.

Final plans for the new lab are taking shape, and work will go ahead immediately, the company says.

The end result will be reliable, producible missile systems, according to Elwood R. Quesada, vice president-general manager of the division, who commanded USAF Tactical Air Command and the Atomic Energy Commission's first thermonuclear (hydrogen) tests at Eniwetok.

"Today's nuclear weapons," Quesada says, "have far outstripped the means of delivering them on a target." This revolution in weapons effectiveness requires a comparable revolution in machines to deliver them, he adds.

Scientists who have joined the new Lockheed research laboratory include these men:

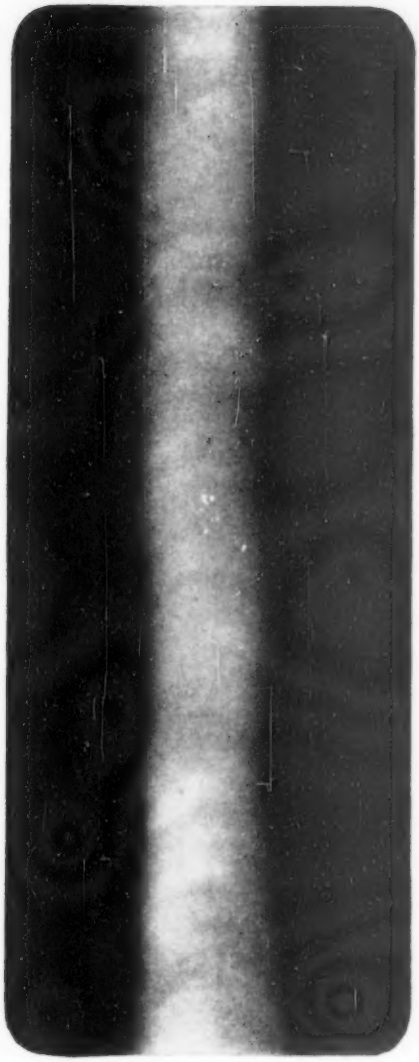
**Dr. E. H. Krause,** head of the facility, who resigned as associate director of research at the Naval Research Laboratory, Washington, D. C., to join Lockheed. Krause directed the nuclear weapons research program conducted jointly by Los Alamos Scientific Laboratory, N. M., and NRL and was in charge of scientific experiments, including instrumentation, at Eniwetok during Operations Sandstone, Greenhouse and Ivy.

**Dr. Montgomery H. Johnson,** associate director, has served since 1952 on the radiation laboratory staff of the University of California, working on nuclear weapons research. He is considered an authority on atomic and nuclear physics, quantum theory, electrodynamics, absorbent materials, atmosphere and ionosphere research.

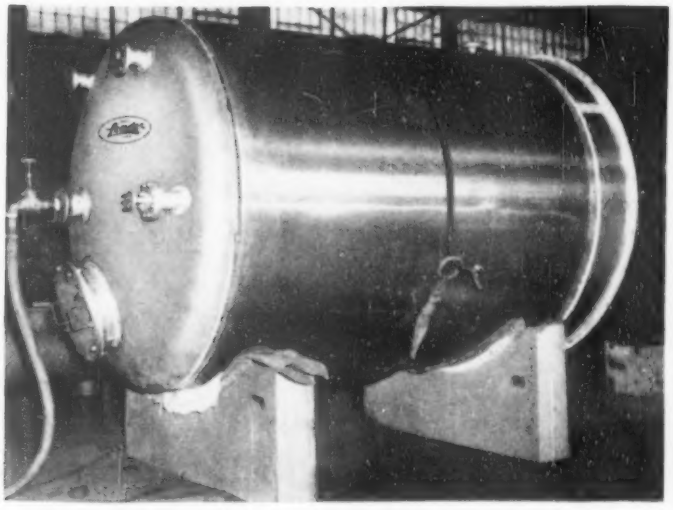
**Dr. Eric Durand,** who comes to Lockheed from Chicago Midway Laboratories, is a specialist in solid-state physics, radiation, infra-red navigation systems, test-range instruments, rockets, bombing aids and ordnance devices.

The staff includes Edward J. Zadine, who resigned as technical adviser and operations analyst with the USAF Special Weapons Center, Kirtland AFB, N. M., and Henry Senf, formerly acting director of development, Air Navigation Development Board of Civil Aeronautics Administration.

Lockheed's Missiles System Division, headed by Willis M. Hawkins, was established in 1953 and now has 700 employes. Employment is expected to reach 1,000 by the end of the present year.



# RADIOGRAPHY makes positive



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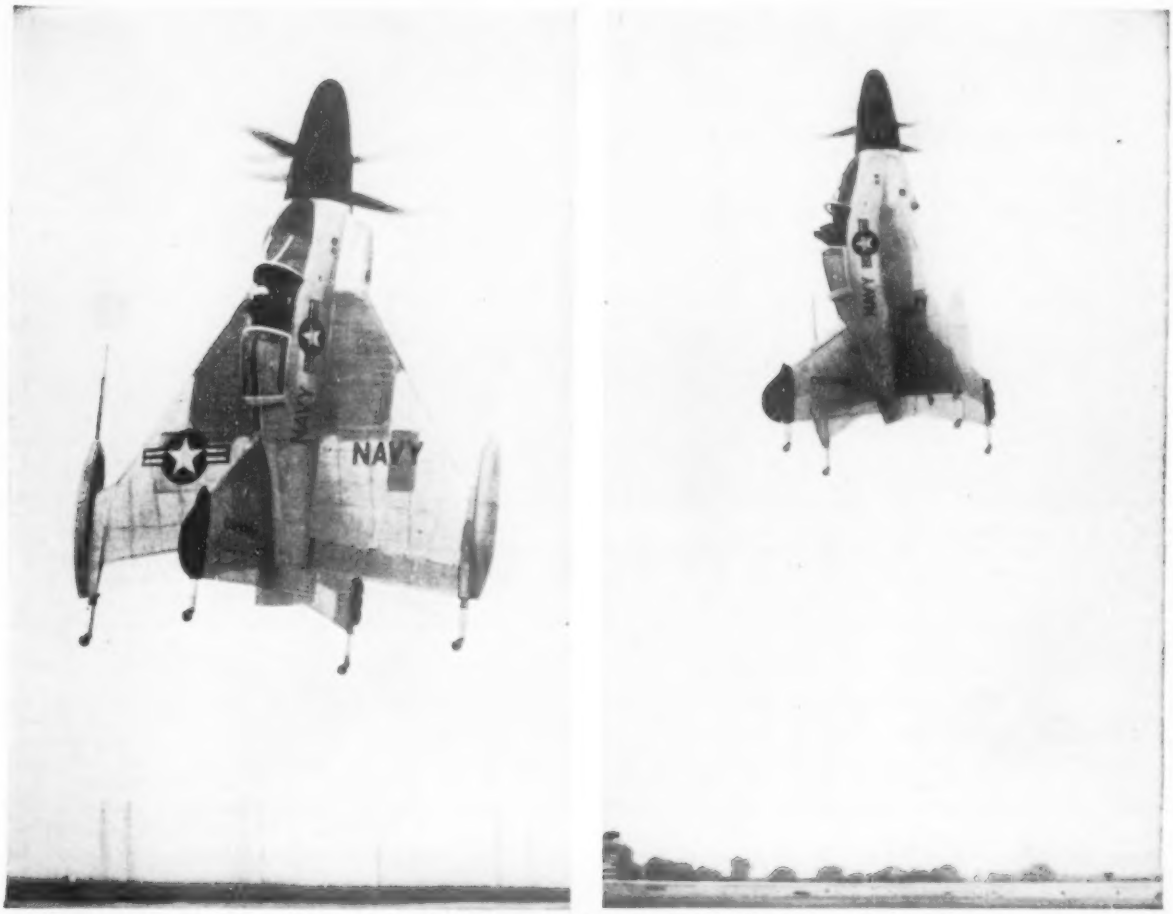
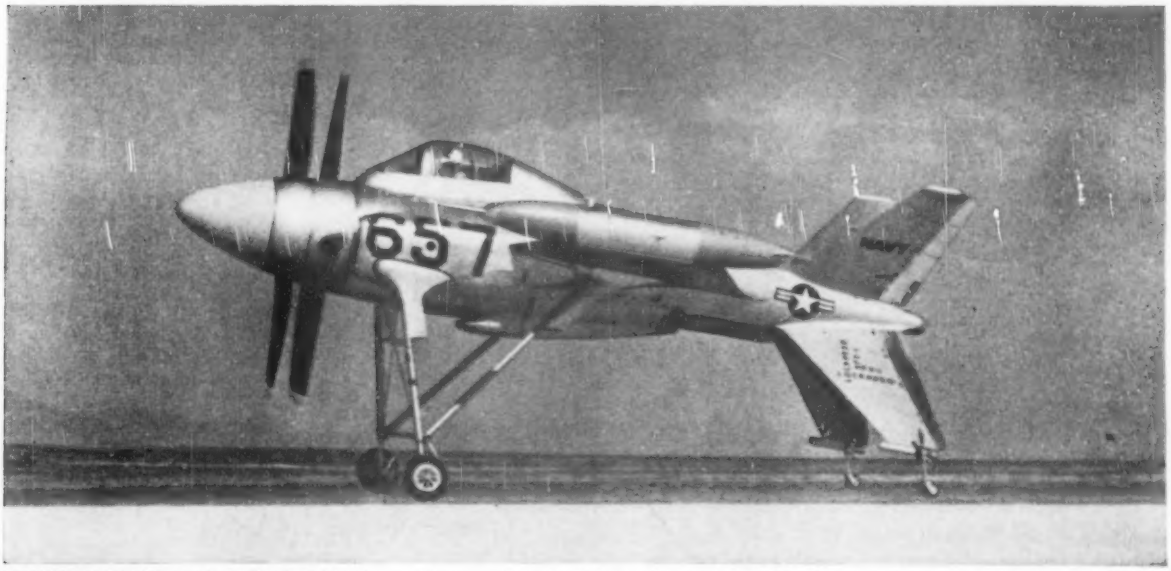



**CONVAIR XFY-1** makes first vertical takeoff Aug. 1, following a brief period of tethered flight tests (Aviation Week June 21, p. 26). On a subsequent flight, the Navy fighter reached 150-ft. altitude. Allison T40 turbine powerplant turns dual Curtiss Turbolectric props.

# Navy VTO Fighters Make First Free Flights




**LOCKHEED XFV-1** vertical-takeoff fighter leaves the ground horizontally on its special fixed landing gear for tests at altitude of its vertical flight capability. Straight-up takeoff and landings await availability of new engines. XFV-1 also has Allison J40 and Curtiss props.

# LA Airport Fights Nike as Hazard

## Officials say missile installation endangers aircraft operation and could halt future growth of terminal.

**Los Angeles**—Army's decision to locate a Nike guided missile battery at Los Angeles International Airport has touched off an angry battle here with city officials who believe the missile battery will be a hazard to airport operations.

The Army wants to place the Nike installation in the airport approach zone.

Airport officials say missile launchers and radar would be a physical danger to the area, would ruin the field's master plan and could affect future growth.

In Washington, D. C., Civil Aeronautics Administrator Fred B. Lee says of the dispute: "While the defense needs are certainly important, we also have to keep in mind the need for planning the future of civil aviation."

Civil Aeronautics Administration is studying possible interference by the Nike installation on airport electronic landing systems.

▶ **'Bull Headed'**—Mayor Norris Poulson carried the fight to Washington after calling local Army representatives "bull-headed" for making what he terms a hasty, shortsighted decision. Poulson protested to California Sens. William F. Knowland and Thomas F. Kuchel and to the Secretaries of the Army, Navy, Air Force and Commerce.

He wants the Army to re-evaluate their need for the site.

Army spokesmen say the airport location is vital to the Nike network now being set up to protect the Los Angeles production area and that the city's protest is causing a dangerous delay. The Army says a deviation from the airport site might make it necessary to shift other Nike batteries in the network.

▶ **20-Ft. Margin**—The Army wants to condemn some 25 acres in the greater International Airport "master" area for the Nike site. Two-thirds of this would be for a launching site at the northwest end of the airport area. The other one-third, sought for radar facilities and barracks, is on the center line of the instrument approach zone a mile to the southwest. Closest unit would be 7,300 ft. west of the present runway.

The Army insists the battery is not a hazard to airport operations. The highest radar mast will be 20 ft. below the minimum glide path for commercial aircraft even when the runway is extended another 1,500 ft. An Army spokesman says he considers this an adequate safety margin.

▶ **Protest Points**—The city, supported by airline operators and manufacturers in the airport area, is basing its protest on these points:

- Location of the facility on the approach center line is a hazard to aircraft taking off and landing at the airport.
- Nike radar equipment may interfere with the airport's electronic navigational facilities.
- Heavy booster rockets that fall away from the missiles after launching are a hazard to the area.
- The installation may affect the development of the airport master plan.

"We've been working for years to achieve an airport that will give Los Angeles the type of international terminal it should have as the nation's fourth busiest air travel center," an airport spokesman says.

"Installation of Nike launchers and radar not only would be a physical danger to the airport area, it would ruin our planning and might well affect future growth of the terminal."

▶ **Defense Keys**—Los Angeles is one of the first cities to be selected for installation of the ground-to-air missiles, and Army spokesmen say the airport location is one of the key points in the local Nike network.

Opponents of the Army plan point out that other land is available in the area a few thousand feet to the north and south.

Brig. Gen. Francis M. Day, commander of the 47th Anti-aircraft Artillery Brigade at Ft. MacArthur, says location of the facility on leased or purchased airport property, as currently planned, would cost about $740,000. He says this could climb as high as $2 million if condemnation of other property is required to shift the site.

▶ **More Deadly Things**—During the argument, the Army listed the facilities planned for the Nike battery, which will include two sections—a launching area and radar tracking center. The unit will contain six launchers supplied from two underground magazines.

Gen. Day says there will be no Nike firing from such batteries unless Los Angeles actually is under attack. The booster rockets for the missile should fall at sea, he added.

"But if we are attacked," the general says, "there'll be more deadly things than booster cases falling through the sky unless the attackers are stopped."

Final decision in the dispute is said to be in the hands of Army Secretary Robert Stevens.—**WJC**

## Improvements Mark New Martin B-57B

**Completely redesigned cockpit canopy, new speed brakes on rear of fuselage and heavy armament are among the changes marking new Martin B-57B. Crew sits in tandem, with navigator-radarman-bombardier having better visibility than he had with B-57A canopy. Armament: eight .50-cal. guns, eight 0.5-in. rockets, napalm tanks or bombs.**

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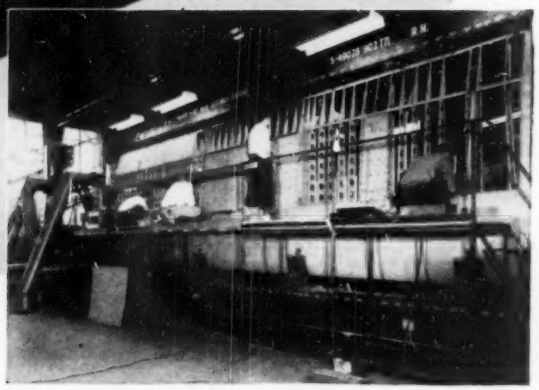

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# EDITORIAL INDEX


## AIR FORCE DEPOT

Britt, Kenneth, Deputy, Management & Procedures, Topeka AFD, p. 90.

Gadsen AFD, Ala., mission, box, p. 90.

Gentile AFD, Dayton, mission, box, p. 90.

How AF Operates Huge 'Hardware Chain,' p. 88.

Mallory AFD, Memphis, mission, box, p. 90.

Materiel Control Division forecasts plane spares 17½ months in advance, p. 90.

Papik, Lt. Col. C. J., Director of Supply & Services, Topeka AFD, p. 88.

Poythress, B. J., Deputy Director, Supplies & Services, Topeka AFD, p. 89.

Readiness Reserve Program underway at AF Depots for D-Day, p. 89.

Reorganization of AF Depots, p. 88.

Reserve of Government Furnished Aircraft Equipment built up by Topeka and Cheli AFDs, p. 89.

Rome AFD, N. Y., mission, box, p. 90.

Single-depot concept begins trials at Topeka and Mallory AFDs, p. 88.

Special Project Branch, Readiness Reserve Program, makes up air-transportable medical supplies, p. 89.

Surplus disposal, p. 90.

Topeka AFD, Kans., mission, box, p. 90.

Wilkins AFD, Shelby, Ohio, mission, box, p. 90.

## AIR MATERIEL AREA

AMA: Supply at the 'Grass Roots' Level, p. 82.

Decentralization, how does it work? p. 86.

Geographic responsibility, p. 83.

Hefley, Brig. Gen. William T., Commander, SMAMA, photo, p. 82.

Logistics support schedules for aircraft, p. 84.

Maintenance Directorate, p. 85.

Overseas Logistical Control Agencies, p. 82.

Perry, Col. Arthur C., Maintenance Directorate, p. 85.

Procurement Directorate, p. 86.

Procurement districts merged with Air Materiel Areas, p. 86.

Ramme, Col. E. L., Supply Directorate, p. 86.

Responsibility for assigned property, p. 83.

Responsibility for weapons systems, p. 83.

Sacramento Air Materiel Area, p. 82.

Supply Directorate, p. 85.

Tellman, Col. H. H., Procurement Directorate, p. 86.

Wynee, John M., Assistant for Programming, p. 86.

## AVIONICS

Gentile Keeps AF Avionics Operational, p. 292.

Hamilton, Col. E. J., Maintenance Engineering Directorate, Gentile AFD, p. 295.

Logistics Support Office, Supply & Services Directorate, Gentile AFD, p. 295.

Mulzer, Col. Leslie, Commander, Gentile AFD, p. 292.

## LOGISTICS

Automatic inventory control, p. 154.

Electronics to Streamline AF Logistics, p. 154.

Gregg, Lt. Col. C. R., Methods Research & Analysis Branch, Comptroller's Office, Air Materiel Command, p. 156.

Greiner, Ralph J., Deputy Chief, Overseas Logistical Control Agency, Sacramento, p. 153.

How AMC Fills Overseas Lifelines, p. 153.

Keller, Col. G. E., Deputy for Plans & Operations, Directorate of Supply & Services, p. 169.

Mason, Col. R. L., Chief, Packaging Branch, Transportation & Packaging Division, Directorate of Supply & Services, AMC, p. 167.

Mercury Service operated by nonskeds under AMC contract, p. 142.

Modifications to Convair XC-99, p. 151.

'Opportune Airlift' trains flight crews and ships cargo simultaneously, p. 169.

Overseas Logistical Control Agencies, p. 153.

Packaging data card system uses code to enable expediting shipments, p. 168.

Packaging Keeps Pace With Air Cargo, p. 167.

Pushbutton machines will replace present methods of filling supply problems, p. 154.

Rand Corp., Santa Monica, Calif., studies AF logistics, p. 173.

Shortage of personnel in developing, operating and maintaining computers, p. 162.

Smith, Maj. Gen. Phillip W. Smith, Comptroller, Air Materiel Command, p. 154.

Spanish Air Materiel Area, p. 147.

Taylor, Maj. J. H., Overseas Logistical Control Agency, Sacramento, p. 153.

Transport & Packaging Division, AMC, p. 147.

Workings of Overseas Logistical Control Agency, p. 153.

## MAINTENANCE

Base for expansion for AMAs and AFDs, p. 248.

B-36 divided into three basic sections under SAM-SAC, p. 267.

Depot Inspection & Repair, (also Disassembly, Inspect and Replace), p. 246.

Directorate of Maintenance Engineering, p. 234.

Engine life increase since implementation of minor repair, chart, p. 284.

Forecasting maintenance workload, p. 235.

How Tinker AFD overhauls jet engines, p. 278.

Industrial Engineering Division, SMAMA, p. 238.

Inspect and Repair as Necessary program, p. 242.

Jet engine life studied using actuarial methods, p. 238.

Jet engine repair found simple in field, p. 251.

Job definitions in Directorate of Maintenance Engineering, p. 234.

Keeping Them Flying is Big Business, p. 234.

Making New Airplanes Out of Old, p. 233.

Minor repair cost vs. cost of overhaul, chart, p. 284.

Oklahoma City Air Materiel Area, p. 278.

Operation SAM-SAC, p. 264.

Organization chart, Directorate, Maintenance Engineering, p. 254.

Project Sight Line supported fire control equipment in Far East in Korean war, p. 252.

## EDITORIAL INDEX


SAM-SAC Keeps B-36s 'Ready to Go,' p. 264.

Sentner, Maj. Gen. W. O., Commander, Oklahoma City Air Materiel Area, p. 178.

Scheduling under IRAN, p. 246.

Screening Board is responsible for SAM-SAC operation, p. 265.

Technical Orders system, p. 251.

Tinker Makes Jet Engines Good As New, p. 278.

Work-measurement standards tested at SMAMA, p. 235.


### MANAGEMENT


Actuarial methods applied to jet engine life expectancy, p. 77.

AMC Streamlines for Supersonic Threat, p. 70.

Boatner, Lt. Gen. Bryant, Deputy USAF Chief of Staff, Materiel, photo, p. 74.

Brandt, Maj. Gen. Carl, Director, Maintenance Engineering, Air Materiel Command, p. 78.

Contracts on Air Materiel Command books for $17 billion, p. 73.

Decentralization of Air Materiel Command, p. 73.

Economy drive by Air Materiel Command, p. 77.

Engines and planes reconditioned in fiscal 1954, p. 73.

Expenditures by AMC, fiscal 1950-54, chart, p. 77.

How AMC spends taxpayer's dollar, chart, p. 74.

Irvine, Maj. Gen. Clarence S., Deputy Commander, Production, Air Materiel Command, p. 78.

Lewis, Roger, Assistant Secretary of Air Force, specializing in Materiel, photo, p. 74.

Local purchase policy eases administrative load for Air Materiel Command, p. 74.

MDAP procurement responsibility retained by Air Materiel Command Headquarters, p. 75.

Merrill Meigs Trophy for Air Materiel Area having best overall performance, p. 79.

Metzger, Maj. Gen. Kern D., Air Materiel Command, p. 78.

Nelson Talbott Award to Air Materiel Area for best procurement and production performance, p. 79.

Organization chart, AMC, pp. 80–81.

Procurement & Production Division, Air Materiel Command, p. 75.

Procurement program, fiscal years 1953-55, chart, p. 75.

Project IRAN cuts cost sharply, p. 77.

Project SAM-SAC prolongs B-36 combat life, p. 77.

Rawlings, Gen. Edwin W., Commander, Air Materiel Command, p. 73.

Reed-King Trophy for AF Depot with best overall performance, p. 79.

Smith, Maj. Gen. Phillip, Air Materiel Command, p. 78.

Spending by Air Materiel Command totaled $11.4 billion in fiscal 1954, p. 72.

Support mission of Air Materiel Command, p. 72.

Total assets of Air Materiel Command are $30 billion, p. 72.

Wright Air Development Center furnishes engineering support for weapons system procurement, p. 75.


### PROCUREMENT


Aeronautical Equipment Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Advice to weapons systems contractors, p. 100.

Aircraft Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Airlines, Maintenance & Service Contracts Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Air Materiel Command contracts, p. 100.

Air Procurement District Offices, addresses, p. 133.

Associate contractor method of securing weapons systems items, chart, p. 94.

Baker, Maj. Gen. David H., Director, Procurement & Production, Air Materiel Command, pp. 93, 106, 111.

Bowe, Col. Hugh H., Chief, Aircraft Division, Procurement Directorate, AMC, photo, p. 106.

Boyles, Palmer, President, National Assn. of Manufacturers Representatives, p. 123.

Brackett, Ernest W., member, AMC Procurement Committee, p. 113.

Burns, Russell, member, AMC Procurement Committee, p. 111.

Cannon, Col. Vincent T., new Deputy Director, Mobilization Planning, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Contract backlog distribution, map, p. 96.

Contractor Furnished Equipment (CFE), p. 95.

Cost-plus-fixed-fee incentive AMC contracts, p. 101.

Cost reimbursable AMC contracts, p. 101.

'Court' Double-Checks AMC Contracts, p. 111.

Demler, Brig. Gen. M. C., Vice-Commander, Wright Air Development Center, p. 96.

Design study phase of weapons systems, p. 93.

Development plan for weapons systems, p. 95.

Directorate of Procurement & Production, AMC, organization chart, p. 107.

Do's and don'ts for AMC personnel, p. 117.

Fixed price AMC contracts, p. 100.

Frost, Joseph, member, AMC Procurement Committee, p. 114.

Government Furnished Aircraft Equipment (GFAE), p. 95.

Guideposts for AMC contracting officers, p. 101.

Hodge, G. Reid, member, AMC Procurement Committee, p. 114.

How AMC Fights Fraud, p. 116.

Industrial Resources Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Industry Helps Carry Weapons System Ball, p. 92.

Irvine, Maj. Gen. Clarence S., Deputy Commander, Production, Air Materiel Command, p. 100.

Life span of a weapons system, chart, p. 102.

MacGregor, Lewis R., member, AMC Procurement Committee, p. 114.

Mincer, Lionel A., member, AMC Procurement Committee, p. 113.

Mitchell, Brig. Gen. Clyde H., new Deputy Director, Production, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Office of Inspection, Procurement & Production Directorate, AMC, p. 116.

Office of Special Investigations, USAF Headquarters, p. 116.

Organization, Directorate of Procurement & Production, AMC, chart, p. 107.

Plant representatives; name, company, jurisdiction, p. 135.

Policy on weapons system contracts, p. 96.

Procurement committee reviews AMC contracts, personnel, p. 111.

Readjustment Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Reshuffle Clears Procurement Channels, p. 106.

Retroactive pricing for AMC contracts, p. 100.

Robinson, Lt. Col. William C., head, Office of Inspection, Production & Procurement Directorate AMC, p. 116.

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## ■ EDITORIAL INDEX


Role of Air Research & Development Command in weapons systems development, p. 93.

Selection of contract methods in weapons systems buying, chart, p. 94.

Service test procurement of a weapons system, p. 95.

Smith, Maj. Gen. Phillips W., Comptroller, AMC, p. 119.

Stratton, Frederick W., member, AMC Procurement Committee, p. 114.

Subcontractor's role in weapons system procurement, p. 95.

Subsystems developed by associate contractors, p. 95.

Support Division, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Team captain responsibilities, AMC-ARDC Weapons System Project Office responsibilities, chart, p. 102.

Thurman, Brig. Gen. William T., new Deputy Director, Procurement, Directorate of Procurement & Production, Air Materiel Command, p. 106.

Weapons systems contracting methods, chart, p. 94.

Weapons systems development and logistics, chart, p. 98.

Weapons systems, management partnership, chart, p. 95.

Weapons System Phasing Group, p. 100.

Weapons System Project Office responsibilities, chart, p. 102.

Where AMC contractors are paid, map, p. 97.


### PRODUCTION


Automatic operation of machine tools, p. 224.

Baker, Maj. Gen. D. H., Office of Director of Procurement & Production, AMC, p. 194.

B-47 master gage program, p. 194.

B-47 Modifications, p. 187.

B-47 Production Committee, p. 194.

Computing spares requirements, p. 199.

Contingency spares needed, p. 211.

Corrective spares sub-program, p. 208.

Cycle maintenance, p. 188.

Dau, Brig. Gen. Frederick, Director, Supply & Services, AMC, pp. 199, 202.

Dental Surgeon Division, Surgeon, AMC, p. 219.

Disher, Lt. Col. R. J., Chairman, B-47 Production Committee, p. 194.

Disposal of surplus spares, p. 212.

Engines reserve required, p. 211.

Follow-on spares sub-program, p. 207.

Gearing Industry for M-Day, p. 223.

Heavy press program, pp. 191, 224, 231.

Industry defense program, p. 230.

Industrial medicine in the USAF, p. 217.

Industrial plant reserve list, p. 223.

Initial spares sub-program, p. 204.

Interchangeability requirements, p. 196.

Investment in spares and spare parts is $10.6 billion, chart, p. 199.

Joint Project Office, AMC & ARDC, p. 178.

King, H. O., Chairman, Spares Study Group, p. 202.

Kuhn, Lt. Col. R. C., WADC-Chief of B-47 Project, p. 178.

Local purchase concept being expanded, p. 207.

Medical Administration Division, Surgeon, AMC, p. 219.

Metzger, Maj. Gen. Kern D., head, Industrial Resources Division, p. 224.

Mobilization excess spares, p. 212.

Moore, Maj. Robert E., AMC-Chief of B-47 Project, p. 178.

New materials, p. 224.

Preparedness contracting program, p. 228.

Producibility program, p. 230.

Production allocation program, p. 230.

Production Division, p. 179.

Production reserve policy and mobilization production base program, p. 227.

Professional Services Division, Surgeon, AMC, p. 219.

Quality Control, p. 183.

Rawlings, Gen. E. W., Commander, AMC, p. 194.

Readiness reserve of spares required to support AF, p. 211.

Spares provisioning, p. 190.

Spares Study Group, Supplies & Services, AMC, p. 199.

Special Production Committee for B-47 comprises Boeing, Lockheed, Douglas and AMC, p. 178.

Weapons phasing group, p. 191.

Weapons Systems Project Office, p. 191.


### Picture Credits

376—Boeing; 378—Lockheed; 379—Vickers-Armstrongs; 380—(top) North American; (lower) Lockheed; 381—Grumman-H. G. Martin; 383—Wide World; 387—(top) Convair; (bottom) Lockheed; 388—Glenn L. Martin.


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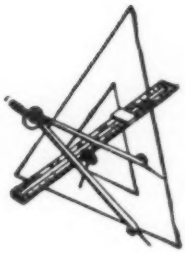

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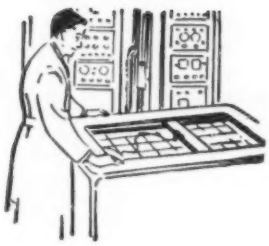

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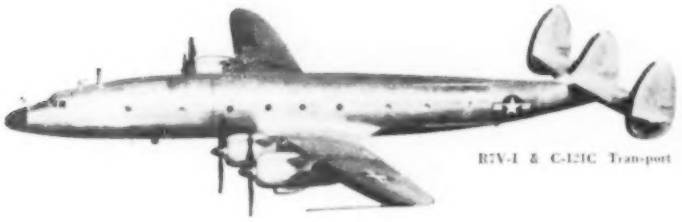

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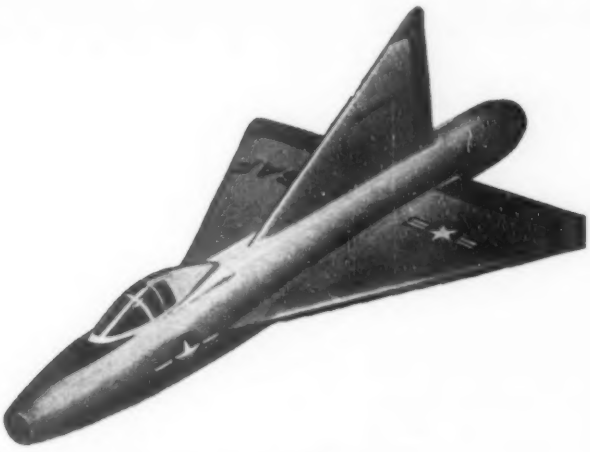

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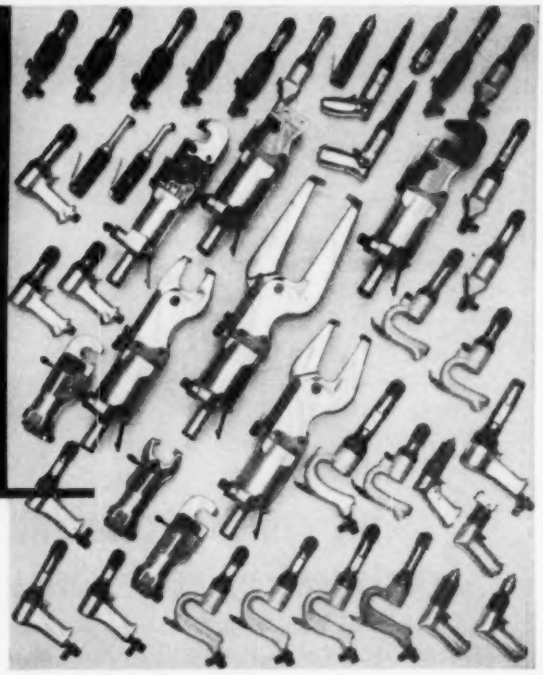

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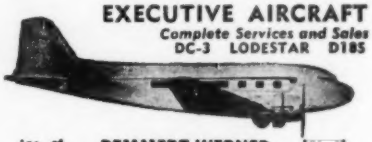

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# ADVERTISERS IN THIS ISSUE

AVIATION WEEK—AUGUST 16, 1954


ABRAMS INSTRUMENT CORP. 198
A. C. SPARK PLUG DIV., G. M. CORP. 56
Agency—D. P. Brother & Co., Inc.
ACME ALUMINUM ALLOYS, INC. 333
Agency—Don Kemper Co., Inc.
ADAMS RITE MFG. CO. 295
Agency—The Shaw Company
ADEL DIV., GENERAL METALS CORP. 373
Agency—The McCarty Company
ADVANCE GEAR & MACHINE CORP. 306
Agency—Mack Wharton Adv.
AERO INSTRUMENT CASTING COMPANY. 346
AEROJET GENERAL CORP. 108, 109
Agency—D'Arcy Advertising Corp.
AEROQUIP CORPORATION 152
Agency—The Fred M. Randall Co.
AIRBORNE ACCESSORIES CORP. 9
Agency—Gray & Rogers Adv.
AIRCOOLED MOTORS, INC. 8
Agency—Richards & Webb, Inc.
AIRCRAFT EQUIPMENT TESTING CO. 183
Agency—Mahool Advertising, Inc.
AIRCRAFT RADIO CORPORATION 255
Agency—Burke, Dowling Adams, Inc.
AIR-MARINE MOTORS, INC. 115
Agency—Walter Wiley Adv., Inc.
AIRPAX PRODUCTS COMPANY 246
AIRWORK CORPORATION 226
Agency—Geare-Marston, Inc.
ALLEN AIRCRAFT PRODUCTS, INC. 364
Agency—Fred Bock Adv. Co.
AMERICAN ELECTRIC MOTORS DIV., AMERICAN ELECTRONICS, INC. 204
Agency—Clyde D. Graham Adv.
AMERICAN GYRO CO. 213
Agency—P. W. Voorhees Advertising
AMERICAN LATEX PRODUCTS CORPORATION 273, 274, 275
Agency—Anderson McConnell Adv.
AMERICAN NON-GRAN BRONZE CO. 372
Agency—Norman P. Hewitt Adv.
AMERICAN OPTICAL COMPANY 375
Agency—Sutherland-Abbott Adv.
AMERICAN PHENOLIC CORP. 148
Agency—Burton Browne Adv.
AMERICAN SEATING COMPANY 58
Agency—Roche, Williams & Cleary, Inc.
AMERICAN WELDING & MFG. COMPANY, THE. 386
Agency—Barbee Kerr Co.
ANTI-CORROSIVE METAL PRODUCTS CO., INC. 366
Agency—Woodard & Voss, Inc.
APPLIED SCIENCE CORPORATION OF PRINCETOWN 203
Agency—Paul M. Healy Adv. Service
ARO EQUIPMENT CORPORATION, THE. 33
Agency—Beeson-Reichert, Inc.
ASTRON CORPORATION 65
Agency—Conti Advertising Agency, Inc.
AUBURN SPARK PLUG CO., INC. 238
Agency—Richards & Webb, Inc.
AUDIO-PRODUCTS CORPORATION 227
Agency—The McCarty Company
AVIATION DEVELOPMENTS, INC. 389
Agency—Jayecraft Co.
AUSTENAL LABORATORIES, INC. (MICROCAST DIVISION) 241
Agency—Frank C. Nahser, Inc.
AVCO-LYCOMING DIV. 182
Agency—Benton & Bowles, Inc.
AXELSON MFG. CO. 169
Agency—C. B. Juneau, Inc.

B. H. AIRCRAFT CO., INC. 324
Agency—Harold Marshall Adv. Co.
BARBER-COLMAN COMPANY 200
Agency—Howard H. Monk & Assoc.
BALMAR CORPORATION, FRANKLIN 132
Agency—Emery Advertising Corp.
BELL AIRCRAFT CORPORATION 337
Agency—Comstock & Company
BENDIX PRODUCTS DIVISION OF BENDIX AVIATION CORP. Third Cover
Agency—MacManus, John & Adams, Inc.
BENDIX RADIO DIVISION OF BENDIX AVIATION CORP. 243
Agency—MacManus, John & Adams, Inc.
BILL JACK SCIENTIFIC INSTRUMENT CO. 310
BLISS COMPANY, E. W. 29
Agency—Feeley Advertising Agency
BOURNS LABORATORIES 201
Agency—The McCarty Company
BREEZE CORPORATIONS, INC. 193
Agency—Burke, Dowling Adams, Inc.
BRIDGEPORT BRASS COMPANY, ALUMINUM DIVISION 368
Agency—Hazard Advertising Company
BRILES MANUFACTURING COMPANY 228
Agency—McKee-Burns Advertising
BRISTOL COMPANY, THE 288
Agency—James Thomas Chirurg Co.
BURTON MANUFACTURING COMPANY 311
Agency—Lee S. Riespiel Adv.

C. & H. INSTRUMENT 302
CAMLOC FASTENER CORPORATION 55
Agency—Lewis Advertising Agency
CANNON ELECTRIC COMPANY 24
Agency—Willand G. Gregory & Company
CEE BEE CHEMICAL COMPANY 323
Agency—The Essig Company
CESSNA AIRCRAFT COMPANY 150
Agency—Gardner Advertising Company
CHAIN BELT COMPANY (SCHAFER BEARING DIVISION) 36
Agency—The Buchen Company
CHANDLER-EVANS DIVISION, NILES-BEMENT-POND COMPANY 156
Agency—Hugh H. Graham & Associates
CINCINNATI MILLING MACHINE COMPANY, THE 351
Agency—The Keelor & Stiles Company
CLEVELAND PNEUMATIC TOOL COMPANY. 197
Agency—Meldrum & Fewsmith, Inc.
CLIFTON PRECISION PRODUCTS COMPANY, INC. 282
Agency—Ivey Advertising Company
COLLINS RADIO COMPANY 138
Agency—W. D. Lyons Co., Inc.
COM-AIR PRODUCTS, INC. 205
Agency—Phil D. McHugh Company
COMMUNICATIONS COMPANY, INC. 162
Agency—Baxter & Crim Advertising Agency
CONSOLIDATED DIESEL ELECTRIC CORPORATION 112
Agency—Woodward & Byron, Inc.
CONSOLIDATED ENGINEERING & MANUFACTURING COMPANY 247
Agency—Hening & Company
CONSOLIDATED VULTEE AIRCRAFT CORPORATION 68
Agency—Buchanan & Company, Inc.
CONTINENTAL AVIATION & ENGINEERING CORP. 314
Agency—The Hopkins Agency
CONTINENTAL MOTORS CORPORATION 315
Agency—The Hopkins Agency
COOK ELECTRIC COMPANY 134
Agency—Glenn-Jordan-Stoetzel, Inc.
COOPER PRECISION PRODUCTS, INC. 218
Agency—Sudler Company Advertising
CORNELIUS COMPANY, THE 145
Agency—Dwyer & Devot Advertising
COX & COMPANY, INC. 357
Agency—Corbin Advertising Agency
CROSLEY GOVERNMENT PRODUCTS DIVISION OF AVCO MFG. CORP. 34
Agency—The Ralph H. Jones Co. Advertising
CURRAN CORPORATION 227
Agency—Cory Snow, Inc.
CURTISS WRIGHT CORPORATION 301
Agency—Burke Dowling Adams, Inc.

DALE PRODUCTS, INC. 311
Agency—Ayres, Swanson & Associates
DAYSTROM INSTRUMENT DIV., DAYSTROM, INC. 290
Agency—Morse Advertising Agency
DE JUR AMSCO CORPORATION 332
Agency—Friend, Reiss, McGlone Advertising
DELRON COMPANY, INC., THE 157
Agency—Abbott Kimball Company of California, Inc.
DOUGLAS AIRCRAFT COMPANY, INC. 253
Agency—J. Walter Thompson Co.
DOW CORNING CORPORATION 239, 240
Agency—Don Wagnitz Advertising
DRI-AIRE INCORPORATED 114
Agency—Woodward & Byron, Inc.
DYNAMIC AIR ENGINEERING INC. 350
Agency—The McCarty Company

EASTMAN KODAK COMPANY 385
Agency—J. Walter Thompson
ECLIPSE-PIONEER DIVISION, BENDIX AVIATION CORP 192
Agency—MacManus, John & Adams, Inc.
EDISON, INC., THOMAS A. 168
Agency—Gaynor & Company
EDO CORPORATION 118
Agency—Davis, Parsons & Strohmeier, Inc.
EKSTROM, CARLSON & COMPANY 271
Agency—Cummings, Brand & McPherson Adv.
ELASTIC STOP NUT CORPORATION OF AMERICA 158
Agency—G. M. Basford
ELECTRICAL INDUSTRIES 361
Agency—George Homer Martin
ELECTRO-AIRE, INC. 147
Agency—Fred C. McElligott & Associates
ELECTROL, INCORPORATED 136
Agency—G. B. Woodin Co.
ELECTRO-TEC CORP. 216
Agency—George Homer Martin
ERWOOD, INCORPORATED 322
Agency—Promotions, Inc.
ESSO EXPORT CORPORATION 329
Agency—McCann-Erickson, Inc.
EX-CELL-O CORPORATION 113
Agency—Holden, Chapin & Larue, Inc.

FAFNIR BEARING COMPANY, THE 6
Agency—Horton-Noyes Co.
FAIRCHILD ENGINE & AIRPLANE CORPORATION 7
Agency—Gaynor & Company
FELT PRODUCTS MFG. CO. 37
Agency—Van Auken, Bagland & Stevens Advertising
FILTORS, INCORPORATED 197
Agency—LaPorte, & Austin, Inc.
FLETCHER AVIATION CORPORATION 208, 306, 313, 335
Agency—The Shaw Company
FLADER, INCORPORATED, FREDERIC. 223
FLIGHT REFUELING, INC. 237
Agency—Davis, Parsons & Strohmeier, Inc.
FLIGHTEX FABRICS, INC. 231
Agency—The Powerad Co., Adv.
FOOTE BROS. GEAR & MACHINE CORP. Fourth Cover
Agency—Waldie & Briggs, Inc.
FORD INSTRUMENT COMPANY, DIVISION OF THE SPERRY CORP. 62
Agency—G. M. Basford Co.

GENERAL BRONZE CORPORATION 359
Agency—Wildrick & Miller, Inc.
GENERAL CONTROLS COMPANY 61
Agency—Hixson & Jorgensen, Inc.
GENERAL ELECTRIC COMPANY 256, 257, 258, 259, 260, 261, 262, 263
Agency—G. M. Basford Company
GENERAL ELECTRIC COMPANY, CHEMICAL DEPT. 303
Agency—Benton & Bowles, Inc.
GENERAL MILLS, INC. (MECHANICAL DIVISION) 285
Agency—Batten, Barton, Durstine & Osborn, Inc.
GENISCO, INCORPORATED 211
Agency—Clyde D. Graham Adv.
GIANNINI & CO., INC., G. M. 277
Agency—Western Adv. Agency, Inc.
GOODYEAR TIRE & RUBBER CO, THE 3
Agency—Kudner Agency, Inc.
GORN ELECTRIC CO. 214
Agency—Renner Advertisers
GREENLEAF INSTRUMENTING CO, THE 20
Agency—Oakleigh R. French & Assoc.
GREER HYDRAULICS, INC. 119
Agency—Dunwoodie Advertising

HAMMARLUND MFG. CO. 286
Agency—Sanger-Funnell, Inc.
HANNAY & SON, INC., CLIFFORD B. 13
Agency—Heverin Advertising Agency, Inc.
HARPER CO., THE H. M. (AERO DIVISION) 45
Agency—The Buchen Co.
HART MANUFACTURING CO., THE 196
Agency—Wilson, Haight, Welch & Grose, Inc.
HARTWELL AVIATION SUPPLY COMPANY 242
Agency—The McCarty Company
HAYDON COMPANY, THE A. W. 184
Agency—Cory Snow, Inc.
HECKER COMPANY, A. W. 296
Agency—H. Grider Advertising, Inc.
HELI-COIL CORPORATION 215
Agency—O. S. Tyson & Company, Inc.
HERMAN NELSON DIVISION, AMERICAN AIR FILTER CO. 405
Agency—Zimmer-McClaskey Adv.
HETHERINGTON, INCORPORATED 202
Agency—The Harry P. Bridge Co.
HOFFMAN LABORATORIES CORP. 365
Agency—Anderson-McConnell Adv. Agency
HUDSON TOOL & DIE COMPANY 355
Agency—George Homer Martin & Assoc.
HUFFORD MACHINE WORKS, INC. 50, 51
Agency—Clyde D. Graham Adv.
HUGHES RESEARCH & DEVELOPMENT LABORATORIES 320
Agency—Foote, Cone & Belding
HYATT BEARINGS DIVISION, G.M. CORP. 66
Agency—D. P. Brother Co.
HYCON MANUFACTURING COMPANY 349
Agency—Hixson & Jorgensen, Inc., Adv.
HYDRO-AIRE, INCORPORATED 362, 363
Agency—Roy S. Durstine, Inc.

INDIANA GEAR WORKS, INC. 218
Agency—Bozell & Jacobs, Inc.
INSTRUMENT CORPORATION OF AMERICA 348
Agency—George Homer Martin Assoc.
INTERNATIONAL ELECTRONIC RESEARCH CORP. 369, 372
Agency—Jayecraft Company
INTERNATIONAL RESISTANCE COMPANY 293
Agency—John Fulkner Arndt & Co., Inc.
INTERNATIONAL STEEL COMPANY 122
Agency—Keller-Crescent Co.
I-T-E CIRCUIT BREAKER COMPANY 291
Agency—Hening & Company, Inc.

JACK & HEINTZ, INC. 232
Agency—Fuller & Smith & Ross, Inc.
JAMES-POND-CLARK 311
Agency—Western Advertising Agency, Inc.
JOHNS MANVILLE CORP. 250
Agency—J. Walter Thompson Co.
JOY MANUFACTURING COMPANY 12
Agency—Walker & Downing, General Agency

KEARFOTT COMPANY, INC. 133
Agency—E. M. Freystadt Associates, Inc.
KEN COOK COMPANY 371
KETAY MANUFACTURING CORP. 120, 121
Agency—Hicks & Greist, Inc.
KOCH & SONS, H. 222
Agency—The J. J. Weiner Co.
KOLLSMAN INSTRUMENT COMPANY 166
Agency—Schaefer & Favre Adv.
KROPP FORGE COMPANY 104
Agency—Advertising Producers Associated, Inc.

LAND-AIR, INC. 170
Agency—Symonds, Mackenzie & Co., Inc.
LAVELLE AIRCRAFT CORP. 224
Agency—The Roland G. E. Ullman Organization

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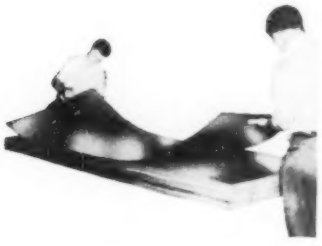

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Agency—The McCarty Company
LEAR, INCORPORATED (GRAND RAPIDS DIVISION) 22, 23
Agency—Buchanan & Co.
LEWIS ENGINEERING CO., THE 230
LIBRASCOPE INCORPORATED 41
Agency—Western Advertising Agency, Inc.
LINK AVIATION, INC 251
Agency—Gaynor & Company
LIQUIDOMETER CORPORATION 326
LOCKHEED AIRCRAFT CORP 312
Agency—Hal Stebbins Advertising
LOCKHEED AIRCRAFT CORP 46, 47
Agency—Foote, Cone & Belding Adv.
LOCKHEED AIRCRAFT CORP 358
Agency—Donahue & Coe, Inc.
LYCOMING DIVISION OF AVCO MFG. CORP. 182
Agency—Benton & Bowles, Inc.

MAG ELECTRIC PRODUCTS CO., INC 328
MANNING, MAXWELL & MOORE, INC. 27
Agency—Fuller & Smith & Ross, Inc.
MARION ELECTRICAL INSTRUMENT CO. 59
Agency—Meissner & Culver, Inc.
MARMAN PRODUCTS COMPANY, INC. 195
Agency—West Marquis, Inc.
MARQUARDT AIRCRAFT CO. 269
Agency—Heintz & Co., Inc.
MARTIN CO., THE GLENN L. 163
Agency—Vansant, Dugdale & Co., Inc.
MAURER, INC., J. A. 343
Agency—Gaynor & Company
M B MANUFACTURING CO., INC., THE 164
Agency—Rickard & Co., Inc.
MENASCO MFG. CO. 347
Agency—The McCarty Company
MILLER INSTRUMENTS, INC., WM 168
Agency—Heintz & Company, Inc.
MINNESOTA MINING & MFG. CO. (SCOTCH-LITE DIVISION) 165
Agency—Batten, Barton, Durstine & Osborn, Inc.
MITCHELL CAMERA CORPORATION 124
Agency—Bozhart-O'Connor Adv.
MONADNOCK MILLS, UNITED CARR FASTENER CORP. 125
Agency—H. B. Humphrey, Alley & Richards, Inc.
MONSANTO CHEMICAL CO. 5
Agency—Gardner Advertising Co.
MOTOR GENERATOR CORP. 143
Agency—Ralph Dalton & Assoc.
MYCALEX CORPORATION OF AMERICA 173
Agency—George Homer Martin Assoc.

NEW DEPARTURE DIV., G.M. CORP. 35
Agency—D. P. Brother & Company, Inc.
NEW YORK AIR BRAKE COMPANY, THE 149
Agency—Humbert & Jones Adv.
NOPCO CHEMICAL COMPANY 60
Agency—Lewin, Williams & Saylor, Inc.
NORTHROP AIRCRAFT, INC. 249
Agency—West-Marquis, Inc.
NORTH AMERICAN AVIATION, INC. 10
Agency—Batten, Barton, Durstine & Osborn, Inc.

OHIO SEAMLESS TUBE DIVISION OF COPPER-WELD STEEL CO. 44
Agency—Howard Swink Adv. Agency, Inc.
OLIVER CORPORATION, THE (AVIATION DIVISION) 229
Agency—Richard E. Putt Advertising
OMOHUNDRO COMPANY, PAUL 171
Agency—Francis D. Gonda Co.
OSTER MFG. COMPANY, JOHN 117
Agency—Henri, Hurst & McDonald, Inc.

PACIFIC DIVISION, BENDIX AVIATION CORP. 42, 43
Agency—The Shaw Company
PACIFIC AIRMOTIVE CORP. 25
Agency—Buchanan & Co., Inc.
PACIFIC LABORATORIES AGENCY 231
Agency—Roy F. Irwin Advertising
PASTUSHIN INDUSTRIES, INC. 103
Agency—Lynn Western, Inc.
PERMACEL TAPE CORP. 276
Agency—The Altkin-Kynett Co.
PESCO PRODUCTS DIVISION, BORG-WARNER CORPORATION 16
Agency—The Jasme Organization, Inc.
PHILLIPS CONTROL CORP. 369
Agency—Schnell & Associates
PIONEER ALUMINUM SUPPLY COMPANY 367
Agency—Boylhart-O'Connor
PIONEER PARACHUTE CO. 38
Agency—Julian Gross Adv. Agency, Inc.
PITTSBURGH PLATE GLASS CO. (SAFETY GLASS) 325
Agency—Batten, Barton, Durstine & Osborn, Inc.
POTTER & BRUMFIELD 212
Agency—LaGrange & Garrison, Inc.
PRECISION GEARS & PRODUCTS, INC. 32
Agency—Gordon-Pilling, Inc.
PROTO TOOLS 4
Agency—Willard G. Gregory & Company
PSP ENGINEERING CO. 208
Agency—L. J. Swain Advertising

RADIO CORPORATION OF AMERICA 39, 210
Agency—Al Paul Lefton Company, Inc.
RADIO RECEPTOR COMPANY, INC. 194
Agency—Walter J. Zimmerman Assoc.
REACTION MOTORS, INC. 352
Agency—London Advertising Agency
RAYMOND ROSEN ENGINEERING PRODUCTS 311
Agency—Al Paul Lefton Co., Inc.
READING BATTERIES, INC. 321
Agency—The William B. Kamp Company
RED BANK DIVISION OF BENDIX AVIATION CORP. 135
Agency—MacManus, John & Adams, Inc.
REEVES INSTRUMENT CORPORATION 110
REM-CRU TITANIUM, INC. 403
Agency—G. M. Basford Co.
REMINGTON RAND, INC. 155
Agency—Leeford Adv. Agency, Inc.
REPUBLIC AVIATION CORP. 49
Agency—Deharnu, Incorporated
RESIN INDUSTRIES, INC. 281
Agency—Tassart & Young Adv.
RESISTOFLEX CORPORATION 297
Agency—Richard & Co., Inc.
REYNOLDS METALS COMPANY 28
Agency—Clinton E. Frank, Inc.
RHEEM MANUFACTURING COMPANY 206
Agency—Campbell-Ewald Company
RICHARD AIRCRAFT SUPPLY COMPANY 324
RIVERSIDE METAL COMPANY (KEYSTONE WATCH CASE DIV.) 272
Agency—Robert S. Kaufmann, Jr.
ROBERTSHAW-FULTON CONTROLS COMPANY 252
Agency—The Griswold-Eshelman Co.
ROBINSON CO., RALPH C. 289
Agency—Chapin Damm Advertising
ROE COMPANY OF CANADA LTD., A. V. 358
Agency—Cockfield Brown & Company, Ltd.
ROHM & HAAS COMPANY 18, 19
Agency—Arndt-Preston-Chapin-Lamb & Keen, Inc.
ROHR AIRCRAFT CORPORATION 316, 317
Agency—Barnes Chase Co.
ROLAND TIERNER CO., THE 374
Agency—Gordon Speedle Adv.
ROYAL JET, INC. 40
Agency—Boylhart-O'Connor Adv.
RYAN AERONAUTICAL COMPANY 37
Agency—Batten, Barton, Durstine & Osborn, Inc.
RYERSON & SON, INC., JOSEPH T. 346
Agency—Aubrey, Finlay, Morley & Hodgson, Inc.

SAFE FLIGHT INSTRUMENT CORP. 336
Agency—Richard & Gunther, Inc.
SAGINAW STEERING GEAR DIV., G. M. CORP. 64
Agency—Price, Tanner & Willox, Inc.
SARGENT ENGINEERING CORP. 209
Agency—Darwin H. Clark Co.
SAWYER & SON CO., THE H. M. 223
Agency—McMillian & Marsden, Inc.
SCHULZ TOOL & MFG. COMPANY 327
SCIAIKY BROTHERS, INC. 172
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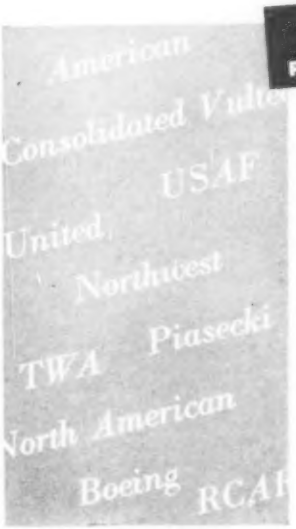


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Agency—MacManus, John & Adams, Inc.
SENSENICH CORP. ..... 322
Agency—Foltz-Wessinger, Inc.
SERVOMECHANISMS, INC. ..... 190, 191
Agency—Sanger-Funnell, Inc.
SHAFER BEARING DIVISION OF CHAIN BELT COMPANY ..... 36
Agency—The Bueben Company
SHELL CHEMICAL CORP ..... 244, 245
Agency—J. Walter Thompson Co.
SHELL OIL CO ..... 393
Agency—J. Walter Thompson Co.
SIMMONDS AEROCESSORIES, INC ..... 52
Agency—Burke, Dowling & Adams, Inc.
SINCLAIR REFINING CO ..... 30, 31
Agency—Morey, Humm & Johnstone, Inc.
SMITH MORRIS CORPORATION ..... 342
SNAP-ON-TOOLS CORPORATION ..... 207
Agency—The Cramer-Krasselt Co.
SOCONY VACUUM OIL COMPANY, INC. ..... 48
Agency—Compton Advertising, Inc.
SONNETT TOOL & MFG. CO ..... 322
Agency—Clyde D. Graham Adv.
SOUTHWEST PRODUCTS CO ..... 294
Agency—O. K. Fagan Adv. Agency
SPENCER THERMOSTAT DIVISION, METALS & CONTROLS CORP. ..... 305
Agency—Sutherland-Abbott Adv.
SPERRY GYROSCOPE CO., DIVISION OF THE SPERRY CORP. ..... 21
Agency—Reach, Yates & Mattoon, Inc.
STANDARD PRESSED STEEL CO ..... 174, 175
Agency—Gray & Rogers Adv.
STANDARD THOMSON CORP ..... 353
Agency—Caldwell, Larkin & Company
STANLEY AVIATION CORPORATION ..... 176
Agency—James G. J. Wells, Inc.
STEEL PRODUCTS ENGINEERING CO ..... 334
Agency—Gever Advertising, Inc.
STEWART WARNER CORP (SOUTH WIND DIV) ..... 186
Agency—MacFarland, Aveyard & Co.
STROUKOFF AIRCRAFT CORPORATION ..... 161
STURTEVANT CO., P. A ..... 214
Agency—Ross Llewellyn, Inc.
SUMMERS GYROSCOPE COMPANY ..... 67
Agency—Byron H. Brown & Staff.
SURFACE COMBUSTION CORP ..... 330, 331
Agency—Ollorne Industrial Adv.
SUTORBILT CORP. ..... 406
SWEDLOW PLASTICS COMPANY ..... 309
Agency—Francis D. Gonda Company

TALCO ENGINEERING CO., INC. ..... 313
Agency—Roger P. Smith Adv. Agency
TELEFLEX, INCORPORATED ..... 284
Agency—John T. Hall & Co.
TEMCO AIRCRAFT CORPORATION ..... 382
Agency—Taylor-Norsworthy, Inc.
THERMO ELECTRIC CO., INC. ..... 308
Agency—Fred Lange Agency, Inc.
THOMPSON AIRCRAFT TIRE CORPORATION ..... 225
Agency—Norton M. Jacobs Adv. Agency
THOMPSON FIBER GLASS COMPANY, H. I ..... 160
Agency—Abbott Kimball Co. of Calif.
TIMKEN ROLLER BEARING COMPANY, THE ..... 17
Agency—Batten, Barton, Durstine & Osborn, Inc.
TOMKINS-JOHNSON CO., THE ..... 123
Agency—Besson-Reichert, Inc.
TOPP INDUSTRIES, INC. ..... 116
Agency—Willard G. Gregory & Company
TORRINGTON CO., THE ..... 146
Agency—Hazard Advertising Co.
TOWNSEND COMPANY ..... 318, 319
Agency—Bond & Starr, Inc.
TRANSPORT EQUIPMENT CO (TECO, INC) ..... 283
Agency—Jaycraft Co.
TRANSWORLD AIRLINES, INC ..... 54
Agency—Batten, Barton, Durstine & Osborn, Inc.
TUBING SEAL CAP, INC ..... 294
Agency—R. M. Hart Advertising
TWIGG INDUSTRIES, INC ..... 63
Agency—LaGrange & Garrison, Inc.
TWIN COACH CO ..... 390
Agency—Palm & Patterson, Inc.

UCINITE DIVISION, UNITED CARR FASTENER CORP. ..... 301
Agency—H. B. Humphrey, Alley & Richards, Inc.
U. S. ELECTRICAL MOTORS, INC. ..... 356
Agency—McCarty Company
UNITED AIRCRAFT PRODUCTS, INC. ..... 189
U. S. STEEL CORPORATION ..... 14, 15
Agency—Batten, Barton, Durstine & Osborn, Inc.
U. S. STEEL CORPORATION (U. S. STEEL SUPPLY DIVISION) ..... 159
Agency—Batten, Barton, Durstine & Osborn, Inc.

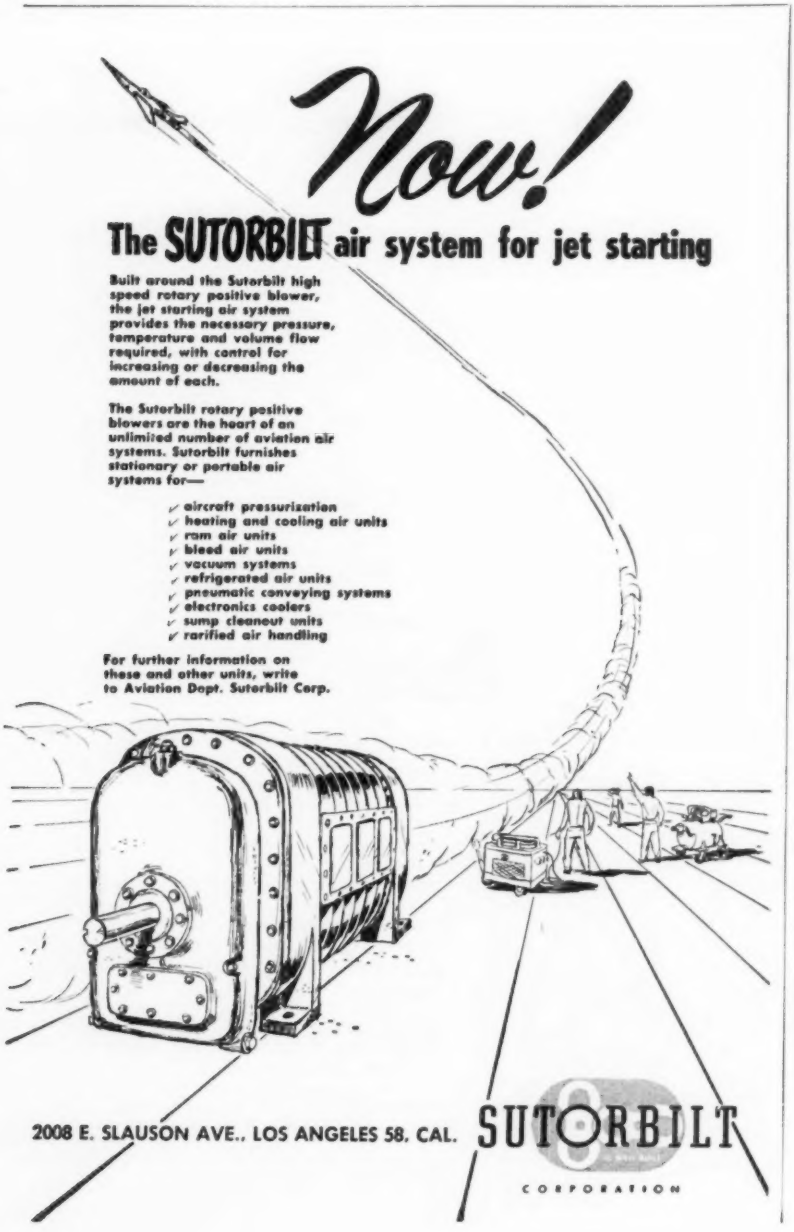
VALCOR ENGINEERING CORPORATION ..... 11
Agency—Adolf F. Gottesmann Adv. Agency
VARD, INC. ..... 220
Agency—The Ensig Company
VERSON ALLSTEEL PRESS COMPANY ..... 298
Agency—Russell T. Gray, Inc.
VICKERS, INC. ..... 344
Agency—Witte & Burden Adv.
VITRO CORP. OF AMERICA ..... 349
Agency—Bozell & Jacobs
VOI-SHAN MFG. COMPANY, INC. ..... 137
Agency—Anderson-McConnell Adv. Agency

WATERTOWN DIVISION, THE NEW YORK AIR BRAKE CO. ..... 149
Agency—Humbert & Jones Adv.
WEBER AIRCRAFT CORP. ..... 144
Agency—Ruthrauff & Ryan, Inc.
WEMAC MFG. CO ..... 270
Agency—McKee-Burns Advertising
WEST COAST ELECTRICAL MFG. COMPANY ..... 335
Agency—Philip J. Meany Co.
WESTERN GEAR WORKS ..... 185
Agency—Ruthrauff & Ryan, Inc.
WESTINGHOUSE AIR BRAKE CO ..... 300
Agency—Batten, Barton, Durstine & Osborn, Inc.
WESTINGHOUSE ELECTRIC CORP. ..... 126, 127, 128, 129, 130, 131
Agency—Fuller & Smith & Ross, Inc.
WHITE INDUSTRIES, INC. ..... 345
Agency—Conti Adv. Agency, Inc.
WHITTAKER CO., LTD., WM. R ..... 219
Agency—Mogge-Privett, Inc.
WILCOX ELECTRIC COMPANY, INC. ..... 53
Agency—Carter Advertising Agency, Inc.
WILDING PICTURE PRODUCTIONS ..... 389
WOLFE CO., INC., FRANKLIN C ..... 307
WYANDOTTE CHEMICALS CORP ..... 151
Agency—Brooke, Smith, French & Dorrance, Inc.
WYMAN GORDON COMPANY ..... 26
Agency—John W. Oklin Co., Inc.

YARDNEY ELECTRICAL CORP ..... 221
Agency—Gaynor & Co., Inc.

ZENITH PLASTICS CO., AIRCRAFT DIVISION ..... Second Cover
Agency—Francis D. Gonda Co.
ZEP AERO ..... 360
Agency—The Shaw Company

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EMPLOYMENT
Positions Vacant ..... 394-399
Positions Wanted ..... 394
Selling Opportunities Wanted ..... 394

SPECIAL SERVICES
To the Industry ..... 400-401

EDUCATIONAL
Banks ..... 401
Schools ..... 398

PLANES—EQUIPMENT
(Used or Surplus New)
For Rent ..... 401
For Sale ..... 400-401

WANTED
Equipment ..... 398

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